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United States Naval Medical Bulletin

PUBLISHED *for the* INFORMATION OF MEDICAL DEPARTMENT *of the* NAVY

THE MISSION OF THE MEDICAL CORPS OF THE NAVY

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TO KEEP AS MANY MEN AT AS MANY GUNS AS MANY DAYS AS POSSIBLE

Issued Quarterly by the Bureau of Medicine and Surgery
Washington, D. C.

VOL. XXXVI JANUARY 1938 No. 1

UNITED STATES NAVAL MEDICAL BULLETIN

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

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PREFACE

The United States Naval Medical Bulletin was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, and reports from various sources, notes, and comments on topics of medical interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

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P. S. Rossiter,
Surgeon General, United States Navy.

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EBEN E. SMITH, EDITOR,
Commander, Medical Corps, United States Navy.

U. S. NAVAL MEDICAL BULLETIN

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SPECIAL ARTICLES

DIABETES AND PROTAMINE INSULIN[1]

By Elliott P. Joslin, M. D., Boston

Insulin was wonderful, spectacular, miraculous. Think of it, children as a result of insulin, instead of dying within the year of the onset of their disease, now have a life expectancy above 30 years. Coma, which used to carry off more than 60 percent of all the diabetics, today is acknowledged to be needless, and the mortality has dropped to about 10 percent, and in the better clinics even during an attack is almost as low. The age at death of diabetics as a whole has risen from 44 to 63 years. Truly, the metamorphosis of the disease diabetes is stupendous.

A hint of what we may expect for diabetics in general has been furnished by the course of the disease in doctors during this same period. Some 300 of these have consulted me for diabetes and the comparison between the doctors and all patients for corresponding age groups shows that whereas the mortality between the ages of 25 and 39 years for doctors is 10 per 1,000, it is 45 per 1,000 for all diabetics. Even at later age periods doctors far exceed the average diabetic. A proper understanding of the disease should dispel coma and, as a matter of fact, but 3 percent of the doctors have succumbed to it in recent years, and there has not been a single death of a doctor in the group from diabetic coma since 1925. The average age at death for doctors generally, is 63 years, but for my diabetic doctors, 68 years. I shall never cease to be grateful to the Metropolitan Life Insurance Co. for the analyses by their statistical department of this group of doctors, because it indicates how much better the possibilities are for all diabetic patients and forces us to revise our measures of medical care.

Furthermore, it should be remembered that these advances have been accomplished with regular insulin, dated from its first discovery when it was an unknown quantity, and do not depend on the more modern methods which have been introduced in the last 2 years.

The factor which has accomplished so much for diabetics as a class is insulin, and for diabetic doctors in particular is insulin plus a knowledge of the disease. That is the key to improvement in treatment.

[1] An informal address delivered at the United States Naval Medical Center, Washington, D. C. Published concurrently in the Military Surgeon.

We must make the knowledge of diabetes more universal, so that in the first place patients who have it will be discovered more closely to the onset of the disease; second, that when they do acquire it they will be able to take advantage of all modern ways of alleviating it, and third, so that both public and patients will grasp the idea that there are simple measures which are now available for this purpose. Above all, however, stands insulin which more than anything else has brought this change about and therefore whatever will promote the use of insulin will improve the status of the diabetic.

The greatest impetus to the extension of the use of insulin has been the discovery of protamine insulin by Dr. Hagedorn of Copenhagen. Already diabetics have caught the essential feature of this discovery, namely, that instead of injecting many doses of insulin each day, one injection will suffice. It is true this could not be accomplished at first with the protamine insulin as described by Doctor Hagedorn, but it is a fact today, because of the improvement in protamine insulin by combining it with zinc. The simplicity of treatment with protamine zinc insulin as compared with regular insulin is obvious to all. Furthermore, it is safer because reactions on the average are less frequent and less severe, and as a rule are accompanied with a warning which the observant patient can recognize.

The control of the diabetes with protamine insulin is far better than with regular insulin. Regular insulin acted for 8 hours or less and two doses would only protect the patient for two-thirds of the day. With protamine insulin the duration of action and consequently the protection are for 24 and more hours. The difference may seem slight at first thought, but when one considers the duration of life of the diabetic today which is certainly 12 years for all and for the average new case more likely 20 years, it is evident that for 4 to 7 years the diabetic treated with regular insulin would be out of control. And it is the uncontrolled diabetic with whom we know that complications are more frequent. Before the discovery of protamine insulin I almost shuddered at the thought of what might happen to the mass of diabetics who lived for years because of the complications they might develop, but now with protamine insulin this worry to a large extent can subside.

The diabetic taking protamine insulin stores glycogen in his liver, his muscles, and skin, so that he resembles a normal individual. He begins his day with a normal blood sugar and without the handicap of a mild acidosis which took place to a greater or less extent during the night when his diabetes was uncontrolled with regular insulin. Indeed, being so closely like a healthy individual, when he exercises violently he is exposed to all the danger a marathon runner would undergo if he started his run fasting before breakfast.

The original protamine insulin of Hagedorn acted for about 12 or 14 hours, so that most of us at first gave regular insulin before breakfast and protamine insulin in the afternoon. The improvement through the addition of zinc has prolonged its action for a day or more so that little by little regular insulin has been rendered unnecessary. This advance in insulin therapy seems very simple but it dates back to Miescher's work in 1868 when he discovered protamines, and to Kossel's work in the final decade of the last century when he observed that a protamine was a protein precipitant. Still more recently it has depended upon a whole group of workers chiefly in the United States from Toronto to California.

Protamine zinc insulin does not deteriorate as was first thought. I have tested specimens which worked perfectly well after 6 months. (Writing in July 1937, I can add that it will act much longer.)

The potency of the insulin is in the precipitate and therefore great pains must be taken that the precipitate in the vial is carefully rotated so that the particles are uniformly diffused in the bottle before it is injected into the patient. It is wonderful to me how well the patients are able to do this, and it speaks much for the skill of the manufacturers, but I suspect it will not be long before even simpler preparations will appear. Incidentally I will add, we have tried protamine zinc insulin U80 and demonstrated that it works perfectly well.

The technique of administration of protamine zinc insulin is simple providing one will bear in mind that its action is slow and persistent for 24 and more hours. One must remember that diet must be adjusted to this slow action. This means that much food should not be given at any one meal but rather spread out through the day with three meals and often three lunches, and second, that provision must be made for exercise. The diabetic patient taking protamine zinc insulin is so nearly normal that with exercise he burns up his carbohydrate completely like a normal person, and therefore he must have carbohydrate to burn. One can lessen regular insulin by a few units if exercise is contemplated, but it does no good to lower protamine insulin by a few units because the effect of its reduction would not be manifest for many hours. Consequently, instead of lowering protamine zinc insulin by a few units for adjustment to exercise, one gives extra carbohydrate. Exercise favors the combustion of carbohydrate with insulin, when either endogenous or exogenous insulin is available, and therefore this also must be borne in mind. I think that most of the reactions which I see from protamine insulin are due to the neglect of this feature. The patient is doing so well, is burning up his carbohydrate so entirely that when he exercises and demands a little more glycogen there is none available and the blood sugar drops to an insulin reaction level.

The dietitian has much more to do for the patient on protamine insulin than for the one on regular insulin. She can spread the meals throughout the 24 hours, an earlier breakfast and a later evening meal. She can see to it that the carbohydrate peaks at meals are reduced by lunches between meals and upon retiring, thus averting night acidosis as well as reactions. Furthermore, by this spreading of the carbohydrate throughout the day its utilization is improved. Protamine insulin is adaptable to any diet but on the whole we have adopted as an optimum about 150 grams, although there are frequent exceptions.

In daily practice, protamine insulin is ideal for the fresh case of diabetes. In various publications I have reported a diabetic who was placed on protamine insulin taking 10 units the first day, 20 units the second day, 30 units the third day, and 40 units the fourth day, and have noted a quick response in lowering of his glycosuria and his blood sugar. Such patients, however, must be kept under close observation because from day to day the protamine accumulates and one must be alert to see when the dose required has been reached. Thus, one of our patients eventually took 50 units, but within 1 or 2 weeks, she dropped to 28 units, and several months later required but 12 units. Similarly, I have seen patients drop their peak from 60 units of protamine insulin to 18 units and even less.

With such early discovered patients, showing a high percentage of sugar in the urine, it is dramatic to have the sugar quantitated for the first 24 hours and show the patient exactly how much he voids. One of our patients reported having drunk 32 glasses of water before the diagnosis was made and I computed she was voiding 1 pound of sugar daily. When she saw its equivalent in a bottle and how day by day the quantity decreased to 0 you can imagine what an education in diabetes it was to her and what an example her case was to my diabetic class.

There are certain elderly people who have taken regular insulin twice daily, 10–0–6 or even 10–0–10 units, and some of these patients can be changed over to the protamine zinc insulin with the dose of 20 units injected before breakfast. This is by no means always the case and never should one attempt to make a transfer from regular insulin to protamine insulin even when dealing with a mild diabetic unless he is under daily observation, even though not in the hospital.

Cases like the two groups mentioned above, however, include the great mass of diabetics in the country and it is for them insulin should be used to the fullest extent, because if they will learn how to use it, certainly the danger of complications will drop.

For patients who have taken insulin for years and have become expert in its use I hesitate to alter their course and change over to protamine zinc insulin as long as they are doing well. Otherwise I ask them to give us 1 or 2 weeks in the hospital and with the under-

standing that for a month or more after discharge they will cooperate closely. Unless this is done, one is bound to get into difficulty and if one single case gets into difficulty it causes so much trouble and talk that the 90 and 9 patients who rejoice and are successful in their use of protamine insulin are forgotten. Please remember that these cases above described are often your best patients, the most reliable, and from whom you have learned much, and therefore have done so well that the chances for a betterment of their state are far less than for many others.

Consider how much these patients have learned to adjust their daily life to three doses of regular insulin, often feeling free to lessen or raise the dose according to whether they plan to go to a dance or a dinner or both combined. They understand their reactions to regular insulin so well that they change it almost automatically according to their needs. Protamine insulin acts very differently, however, and it is not easy for these patients to learn how to adjust themselves to it and we doctors cannot tell them easily.

In general when transferring from regular to protamine insulin the patient, who before the transfer might be taking regular insulin 24–0–18, would continue the same morning dose of regular insulin, but would be given at the same time the remaining units of regular insulin employed during the day as protamine insulin. Dr. Priscilla White says that with the children she often doubles the balance of units for the day; thus the above patient might be given a prescription of regular insulin, 24 units plus protamine insulin 36 units. Gradually thereafter, one attempts to lower the regular insulin and often to do so one must increase the protamine insulin to offset it. Frequently one is gratified to find a patient who will react exceptionally well to the change and others in the course of months who will change from 10 units of regular insulin plus 40 units of protamine zinc insulin to 50 units of protamine zinc insulin. This of course makes treatment very simple for the patient and will be still easier when U80 protamine zinc insulin is on the market.

Our dependence upon the laboratory is even greater with protamine zinc insulin than with regular insulin, but in a somewhat different manner. Thus we use 24-hour specimens with the total glucose as guides of treatment much more than for the last few years. We have reverted to carbohydrate and glucose balances of the Naunyn and Allen eras. A patient might be taking 150 grams of carbohydrate and his urine is examined several times a day, some of the tests may have been yellow, or red, or orange with Benedict's solution. The patient gets discouraged, but if it is demonstrated to him that these specimens represent a small fraction of the 24 hours, and the loss of glucose is very slight, he is reassured. The patient may void a single specimen of urine containing even 3 percent sugar but the aggregate

glucose excreted very likely would not exceed 15 grams and if his diet contained 150 grams carbohydrate it would show that, as a matter of fact, he is 90 percent controlled. And this takes no account of glucose formed from protein or fat. More and more I believe you will see that the 24-hour tests of urine for patients using protamine zinc insulin are valuable.

The second specimen test is also most useful. For years we have utilized that in differentiating between coma and insulin reactions. The first specimen voided might be confusing, because during a reaction the urine might show sugar, because hours might have intervened since the bladder was emptied, yet a second specimen would be sugar-free. This is in contrast to diabetic coma, in which the second specimen invariably would contain sugar. Then, too, the second specimen is valuable for the patient on rising in the morning for the same reason. Repeatedly when we began with protamine zinc insulin we made mistakes and added regular insulin to the dosage with protamine insulin for the patient before breakfast, when if we simply had done a second test following the voiding of urine which collected during the night we would have found the patient sugar-free.

Capillary blood sugars in contradistinction to venous blood sugars must be used far more extensively in this country than hitherto, not only for the sake of little children whose lives will be saved thereby, but because you can do more tests in one day with less annoyance to the patient. Furthermore, so often patients with protamine zinc insulin are sugar-free that one is in a quandary whether or not the dose should be changed, but with more frequent blood sugar tests one can act more rationally. The fasting capillary blood sugar is identical with that done upon venous blood. But after a meal one must make allowance for the capillary blood to be higher. Arbitrarily we have put the difference at 0.03 (30 milligrams) percent, but of course this is not at all accurate.

I cannot say enough for the necessity of a laboratory being available day and night and holidays for diabetics. In this way one can secure tests which are of the utmost help in treatment of coma. Presumably we have had at the New England Deaconess Hospital about as many diabetic comas to treat as anywhere and yet not one of my colleagues would forego the help which we receive from the tests of blood sugar, carbon dioxide combining power, salt, and nonprotein-nitrogen. We cannot help wondering how others (who have had less experience) can get along without these aids. We are as anxious to simplify treatment as anybody. We report every death of diabetic coma, even though he may not die for 3 or 4 months after treatment for the coma and from complications, because we want everyone to see that we lean over backwards in reporting deaths. We have had one death in 83 children we have treated for

diabetic coma from 1923 to September 1936. One of our patients recovered from diabetic coma who was 75 years old, but the mortality for 338 cases has averaged 17.1 percent.

One can practice guess medicine, but in general it is not justifiable. I make enough mistakes as it is without deliberately taking chances.

Insulin reactions occur with protamine insulin but as a rule they come on more gradually and are less severe. They are distinctive because of two symptoms not met with in the course of reactions with regular insulin, namely, nausea and headache. It is particularly unfortunate that nausea is a symptom, because that is also a symptom of diabetic coma and it makes the diagnosis between coma and a protamine insulin reaction more difficult and, at the same time, between these two and appendicitis. The nausea may persist for hours and greatly interferes with the taking of food. At such times one must place the patient on quite a free choice of liquids, but it is unlikely that he will take too much carbohydrate, because even if 500 cubic centimeters of orange juice or gingerale and 1 quart of milk are consumed during the greater part of the day, one is giving the patient only about 100 grams of carbohydrate. The headache is likewise disagreeable. Headaches are so uncommon in diabetes that this symptom is particularly annoying to the patients and interferes with a gain in health. Look out therefore not to overtreat the patient and thus make him as wretched as he made himself with undertreatment.

Reactions from protamine insulin are more apt to occur in the midafternoon or during the night, and rarely just before breakfast. To avoid them, one takes 5 or 10 grams of carbohydrate between meals and also upon retiring. Sometimes patients take 5 or 10 grams of carbohydrate upon going to bed with 30 grams of cheese. Other patients take 30 grams of nuts, and still others, 180 grams of milk so that they will be afforded protection from an insulin reaction during the night.

If regular insulin is given along with protamine insulin before breakfast one must look out that a reaction does not occur before the meal. Under such circumstances patients should take their regular insulin only 15 minutes before breakfast because the blood sugar is apt to be low at that time.

Deaths from protamine insulin reactions certainly must be rare because I have seen but one in the literature, and none have occurred in our group of cases taking this form of insulin, although the present number certainly must reach 1,600 patients.

Treatment of a reaction of any sort should be prompt and if recovery is delayed for more than one-half hour glucose should be given intravenously. If the reaction is really severe, glucose may be administered continuously in 5 percent salt solution during several

hours. It is a fact that both with reactions due to regular insulin and to protamine insulin, recovery does not take place coincidently with a rise of the blood sugar to normal.

The blood sugar may almost disappear during a reaction with either regular or protamine insulin, if one actually determines the fermentable blood sugar. Furthermore occasionally the blood sugar may fall to very low levels with children and sometimes with adults, and yet scarcely any symptoms may be noticeable. For a discussion of hypoglycemia, with literature, I would refer the reader to the sixth edition of my monograph on diabetes.

I think diabetes is a good disease for a great many reasons. First of all, one is dealing with facts. Carbohydrate in the diet can be calculated with reasonable accuracy and the excretion of sugar in the urine balanced against it. The blood sugar is normal or abnormal. The carbon dioxide combining power is normal, high, or low. If the patient does not do well there is a reason.

Recently I had difficulty while transferring one patient to protamine insulin, and it turned out at this time catamenia came on and upset the program for several days. As you are aware diabetes is apt to be worse during menstruation and occasionally coma develops at such times. While struggling with this patient I had complaints from another that the protamine insulin was not working well, but before the day passed a telegram came and the patient apologized and said that she had made a mistake in measuring her insulin. A third instance of trouble developed and poor protamine insulin was blamed, but when the shingles broke out 2 days later the explanation of the difficulty was at hand. In the fourth instance, so soon as the site of the injection of insulin was changed so that absorption was more marked, the diabetes responded better to treatment. Finally a telegram was received that a patient had died of an insulin reaction. Persistence in following up this tragic telegram and sending a pathologist some 200 miles demonstrated to all that there was an absolute occlusion of the coronary artery showing the cause of death. Therefore, when there is anything unusual in diabetes, I say there is a reason and we must always find out the reason because diabetes is a good disease.

Prevention counts in diabetes. One cannot alter heredity but one can arrange for one's posterity. Two diabetics should not get married, because theoretically all their offspring would develop the disease. We should not say too much about this, because even if they did have 100 children only 44 of the hundred would live long enough to come down with the disease. The others would succumb to other causes before they reached the decade they were destined to show it. As you are aware, the onset of diabetes throughout the world appears quite uniformly in the same percentages per decade of life. If the

heredity is less strong, of course, the percentage of those developing the disease would be correspondingly less. The inciting cause, moreover, in the hereditarily predisposed is well known. It is obesity which becomes increasingly manifest after the age of about 30 years. Between 60 and 70 years of age only one of my patients developed the disease who had been thin throughout his life.

Statistics such as those collected by Dr. Matz of the Veterans' Bureau are ideal, because the follow-up of the patient is so perfect. A veteran acquires diabetes, and there is little doubt but he will draw a pension as long as he lives, and consequently there is no difficulty in tracing him. I think the work that Colonel Matz has done is most valuable along this line and that he has started something the importance of which none of us can foresee. Who would have thought that in his group of patients the duration of the disease would have already reached the average of 9 years? I look for great progress and advance in the treatment of diabetes from the studies which will be carried on in the Army and Navy. Of course, the number of cases will increase many, many times because two-thirds of all diabetes develop the disease above the age of 40 years, and as yet the veterans are only beginning to march past that landmark.

Cooperation in diabetic treatment is just as important as cooperation in the Army. Nothing can be accomplished of value without officer and private, doctor and patient, working hand in hand. But this principle extends further. A diabetic does not live to himself alone. If he lives safely he has health, but if he lives carelessly, he develops coma, hypoglycemia, or a multitude of complications.

COMPRESSED-AIR ILLNESS [1]

By Charles W. Shilling, Lieutenant, Medical Corps, United States Navy

Introduction

The purpose of this paper is to present an impartial review of all of the available literature on compressed-air illness. This material has been collected, translated, read, analyzed, and classified, and a brief review of its forms the basis of the paper. No new ideas, original studies, or unpublished researches are reported.

The study has been divided into the following sections: History, cause, symptoms, treatment, prognosis, prophylaxis, and general bibliography. Immediately following the introduction there appears a list of those books and articles covering all phases of the subject

[1] This work was made possible by the assistance given by N. J. Cabana, machinist mate, second class, U. S. Navy; Mr. Walter Oliver, Panama City; Mr. M. C. Roemer, Navy Yard, Washington, D. C.; and Mrs. C. W. Shilling in translating the various works, and by F. E. Lusk, first class pharmacist mate, U. S. Navy, in collecting the references.

which are recommended for a general consideration of this entire field, although they do not, in every case, give the latest advances in all phases of this subject. Then, following each section there appears a double bibliography; the first being those references from which the ideas incorporated in this review have been taken, the second being references on the same phase of the subject but considered to be of secondary importance. At the conclusion of the paper, in order that the bibliography may be complete, there appears a list of references so general in their concept and treatment that they could not be included under any single heading, and which are considered to be valueless in a study of this nature.

In order to focus our attention exclusively on compressed-air illness the articles covering the following commonly associated subjects have been excluded:

1. *Accidents to divers other than compressed-air illness.*—Under this heading are articles concerning asphyxia, blowing up, drowning, exhaustion, mechanical injuries and squeeze.

2. *General articles on deep sea diving not primarily concerned with compressed-air illness.*—This also includes all articles concerning diving suits, bells, caissons, diving ships, recompression chambers, salvage of sunken wrecks, and treasure hunts involving diving.

3. *Ear conditions.*—Although it is well recognized that increased air pressure affects the ears, inasmuch as this is not considered a part of compressed-air illness these studies have been excluded.

4. *Oxygen poisoning.*—These articles deal with poisoning caused by breathing high pressure oxygen, or with oxygen effects of high pressure air.

5. *Normal physiology and pathology under increased air pressure.*—Under this heading are the articles on the effects of increased air pressure on the pulse, blood pressure, blood volume, velocity of blood flow, vital capacity, metabolism, etc.

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I. History

Classical historians record for us many stories of the employment of "naked" divers, even as early as 460 B. C. In the intervening centuries men have continued to dive to great depths without any type of suit and even today in many parts of the world similar practices are employed by those engaged as pearl or sponge divers.

From the days of Aristotle attempts were made to construct a satisfactory diving dress so that the divers could breathe under water. It was not until 1819, however, that a practical diving helmet was produced and not until 1837 that a satisfactory complete diving dress was made by Siebe of England.

Diving bells were referred to as early as 360 B. C., but the first practical one was built by Taisner in the sixteenth century. In 1665 attempts were made to recover portions of the Spanish Armada by the use of a diving bell. However, it was not until the introduction of compressed air by John Smeaton (1678) that the use of the diving bell became successful.

The use of compressed air in the treatment of disease was proposed by Dr. H. Henshaw in 1664 but it was not until 1836 when Junod published his exhaustive study on the same subject that it became widely used. The pressure of the air used, however, was so low that compressed-air illness was impossible. Robert Boyle in 1670 was the first to observe gas bubbles in the blood as a result of subjecting animals to suddenly decreased air pressure.

Compressed air was first used in a mining project by a French engineer, M. Triger (1841), and he mentions symptoms experienced by the workers after their exposure to increased air pressure which were undoubtedly due to compressed-air illness. Similar symptoms were observed by the physicians Hamel (1820) and Colladon (1826) which they attributed to neuralgia. The first report of scientific value was published by two French doctors, Pol and Watelle (1845) who recog-

nized clearly the nature of the illness and presented a complete discussion with many case histories.

In addition to the well established use of compressed air in diving and mining, in 1850 it had its first use in pier building in England, and in 1879 in tunnel construction under the Hudson in the United States.

With the increasing use of compressed air in construction there were many occurrences of this strange new illness, which was variously known as diver's palsy, diver's paralysis, caisson disease, aeropathy, "bends," and compressed-air illness. Among the workmen, according to Aldrich (1904), the illness was known by various names, each usually significant of some prominent symptom. Thus we find "bends" for abdominal pain (loosely used for any attack), "chokers or chokes" for dyspnea or a choking feeling, "staggers" for vertigo, "itch," "prickles," or "lice" for pruritus of the skin, and "fits" for convulsions.

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II. Cause of Compressed-Air Illness

From a study of the many theories advanced as to the cause of compressed-air illness it is evident that most of the authors were not familiar with the literature and so laboriously developed individual theories. The most unusual is that of Bouchard (1869) which has to do with the expansion of gas in the intestine causing rupture and fatal hemorrhage. Jaminent (1871) attributed the cause to exhaustion from excessive tissue-waste brought about by increased absorption of oxygen. MacMorran (1902) believed the cause to be due to hyperemia of the nerve centers from mechanical pressure and accumulated CO^2 in the blood owing to imperfect interchange of gases in the lungs. Merget (1905) believes the condition to be due to air embolism from rupture of the alveoli upon rapid decompression. Abbamondi (1906) said that rapid compression caused tissue damage predisposing to compressed-air illness on final emergence. MacNaughton (1906) attributed the disease to frictional electricity encountered while exposed to compressed air. Conroy (1910) attributed the illness to "nothing else than a toxemia, due to excessive catabolism."

However, most of the theories as to cause fall under the following three classifications: 1, The theory of exhaustion and cold; 2, the theory of mechanical congestion with sequelae; and, 3, the gaseous emboli theory.

1. The theory of exhaustion and cold has for its proponents Bouhy (1848), Barella (1868), Lampadarious (1891), and Woodward (1881). They said that when the pressure was reduced and the temperature of the air dropped there was produced a very marked exhaustion of the body system causing neuralgic and rheumatic symptoms. The spinal cord damage was the result of reflex action caused by "spontaneous refrigeration" of the whole system.

2. The mechanical congestion theory states, in general, that when the body is exposed to air pressure the peripheral blood vessels are compressed or collapsed by the pressure on the skin surface and the blood is driven into the visceral organs and especially those organs—the brain and spinal cord—which are protected by bony cases from this external air pressure. The sequelae which are the specific cause of the illness are: "Black blood," "evolution of gas," "hemorrhage," "acute revulsive anemia," or "comparative stasis."

"Black blood," held to be the cause by Gueard (1854), Limousin (1863), and Bauer (1870), was the blood deprived of its oxygen which was held in the congested internal vessels and caused a "stupefying action" on the tissues.

The sequela, "evolution of gas," advanced as the cause by Boucquoy (1861) came very close to the true theory, but he says that the gas liberation is due to internal congestion followed by sudden release of pressure, and that it is only liberated in the internal organs and tissues.

"Hemorrhage" was the cause advanced by Babbington and Cuthbert (1863), and Febvre (1879). It was due to rupture of the distended internal vessels by the pressure of the blood being forced in from the periphera.

"Acute revulsive anemia," according to Moxon (1881) and Twynam, (1888) was due to the great rush of blood from the congested internal to the empty external vessels upon rapid reduction of the external air pressure, thus leaving the internal organs a prey to dangerous anemia.

"Comparative stasis" was the causative sequela supported by Smith (1873, 1894), Nixon (1889), Knapp (1891), Edelheit (1896), Snell (1897), and Porter (1907). This theory holds that the gorged internal vessels have become paralyzed due to overdistention and are unable to regain their elasticity when the external air pressure is released and the peripheral blood flow reinaugurated; thus there is a comparative stasis existing in the internal organs which leads to tissue damage. Van Rensselaer (1891) supports this theory and also gives a most complete review of the entire literature on the cause of the

illness. Meigs (1885) says the disease is due to a combination of the foregoing causes.

3. The gaseous emboli theory, in one form or another, has had the following advocates: Boyle (1670), Musschenbrock (1755), Hoppe (1857), Francois (1860), Bert (1873), Leyden (1879), Cassaet (1886), Catsaras (1888, 1889, 1890), Zuntz (1897), Greenwood (1908), Grimbach (1909), Oudard (1911), Hill (1912), and Keyser (1916). All authors writing since 1916 have accepted this theory and of course all of the authors mentioned in the introduction to this paper were ardent advocates of the gaseous emboli theory. Experimental work was performed by Oliver (1906) and Quincke (1910) to demonstrate the truth of bubble formation.

The gaseous emboli theory is based on the fact that as the individual breathes compressed air, whether it be in a diving suit, bell, caisson, or tunnel, the blood circulating through the lungs is exposed to a partial pressure of nitrogen and oxygen proportional to the air pressure, and takes up an extra amount of nitrogen and oxygen proportional to this increased pressure. As the blood circulates through the body the extra oxygen is used by the tissues but the extra nitrogen is not used, and gradually saturates all of the tissues until they are charged with nitrogen at the partial pressure existing in the air breathed. It is evident at once that there are two factors involved in this saturation, namely, the depth or degree of pressure and the length of time exposed to this pressure.

If the air pressure is lowered slowly (decompression) then the process is reversed and the nitrogen is given off through the lungs and equilibrium again established with atmospheric air pressure. But if decompression is too rapid, the blood and tissues, which are supersaturated with nitrogen, are left with an internal partial pressure far above the external atmospheric pressure. Under these conditions the nitrogen tends to leave the blood and tissues in bubble form and produce local or general blockage of the circulation; or as pointed out by Brooks (1907, 1907–08) they may produce painful pressure or tearing of the tissues. The symptoms of the illness vary according to the location of these bubbles and the local tissue damage produced.

Thus we have three principal factors involved in the production of compressed-air illness: Degree of air pressure to which exposed, length of time exposed to this pressure, and the length of time taken to come out from this pressure to atmospheric pressure. In addition to these we have certain physical predispositions having a seondary bearing on the production of the illness which are:

Age.—The ideal age for air-pressure workers is considered to be between 20 and 40 years, for during that period the cardio-vascular system is at its greatest efficiency and is best able to withstand the trauma of taking air pressure.

Systemic disease.—Individuals with any weakness, abnormality, or disease of the heart, lungs, or kidneys, or other general disorders are subject to caisson disease and are to be ruled out at the first examination.

Degree of fatness.—As pointed out by Vernon (1907) and Boycott and Damant (1908), fat at body temperature dissolves more than five times as much nitrogen as an equal volume of water or blood plasma. Thus a fat man would be a poor risk since his tissues would not only contain more nitrogen but also give it up more slowly because of the poor blood supply to adipose tissue, and thus be more likely to bubble formation during decompression.

Alcoholic consumption.—All authors agree that alcoholics should be excluded from increased air pressure work because of the changed cardio-vascular responses produced by consumption of alcohol.

Fatigue or general malaise.—No man should be exposed to increased air pressure who feels below par physically, for careful history taking has demonstrated a definite relation between a feeling of indisposition and the incidence of compressed-air illness. For the same reason acute upper respiratory disease or other acute disease should exclude the individual until recovery is complete. Gallivan (1907) points out that lowered vitality of any part means lowered metabolism and circulation and thus slower elimination of the nitrogen stored in the tissues of that part. In this connection it should be noted that during decompression if the person, who has been working hard under pressure and thus saturating rapidly, ceases to exercise or becomes chilled there may be such a drop in the metabolism, heart rate and volume output, and velocity of blood flow that the excess nitrogen is not eliminated and bubble formation ensues.

In addition to these physical causes Thomson (1913), O'Donnell (1929), and many others have pointed out that excessive dampness and foul or vitiated air are contributing causes of compressed-air illness.

All of these points will be considered in more detail in the section on prophylaxis.

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TREATMENT OF HAY FEVER WITH ALUM-PRECIPITATED POLLEN EXTRACT

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The history of hay fever begins with Botallus, who in his writings on the Duties of the Doctor, published in 1565, gives an account of the ill effects, headache, sneezing, and coryza, produced by smelling roses. Following Botallus, the next step forward did not occur until 1819, when John Bostock read a paper at a meeting of the Medical-Chirurgical Society of Boston giving a minute and accurate clinical description of his own case of hay fever. Bostock, in his second paper, read in 1828, referred to his malady as "summer catarrh" and thought that the condition was due to heat and sun rays. Also, in this second paper, the term "hay fever" appears for the first time in medical literature. Elliotson did not agree with Bostock as to the causation of hay fever, and in 1831 he gave a lecture at St. Thomas Hospital in which he referred to flowers and pollen as the cause. In 1870 Dr. George Moore claimed credit for the discovery of what he called the pathognomonic sign of the disease, i. e., excessive coldness of the tip of the nose. About this time Von Helmholtz advanced the opinion from experiments on himself that the condition was due to "certain vibrio-like bodies (infusoria)", and thus the bacterial theory of the disease was born. Due to Von Helmholtz's standing in the scientific world, the microbic theory of the disease became very popular, thereby retarding the discovery of the real causation. Dr. Swett, an American, in 1852 gave an account of an "autumnal catarrh"; and as early as 1854 Morrill Wyman described the ailment in his clinical lectures at Harvard.

Charles Harrison Blackley, a physician of Manchester, England, was the outstanding investigator of hay fever during the nineteenth century. By many experiments he proved that hay fever was due to the pollen of grasses. He produced hay fever by placing pollen in the nose of hay-fever subjects during the months when pollen was not usually present in the air. He rubbed pollen into the skin of the arm and leg and produced violent reactions. This is the first record of skin tests made with pollen. Blackley also made pollen counts and showed that pollen had their greatest concentration in rural sections. In 1881 Dale, of Pittsburgh, advanced the idea that hay fever was due to a pathological condition in the nose, that certain sensitive areas were responsible for its initiation, and that treatment should be directed locally to the nose. It was not until 1903 that the controversy as to the etiology of hay fever was finally settled by the work of W. P. Dunbar and the germ and nasal theorists were converted.

Dunbar extracted an albuminous substance from pollen capable of producing symptoms of hay fever in susceptible people which he

thought was a toxin. He then attempted to elaborate an antitoxin by injecting horses and other animals with increasing doses of pollen, endeavoring to duplicate in hay fever the beneficial results of antitoxin in diphtheria. The serum was patented and marketed under the trade name Pollantin. Not long after this, Weichardt introduced Graminol, a serum obtained from herbivorous animals that had not been intentionally immunized, the idea being that such animals would automatically "create the antitoxin" from eating the various grasses. Neither of these sera was of much value in treatment, although this method of therapy was the one of choice for many years. The current method of therapy followed the work of Noon, who published a paper in 1911 reporting the results obtained by subcutaneous injections of pollen extracts. The concepts of Noon and Freeman, as reported in this paper, led to the treatment of pollinosis on a scientific and practical basis. Noon's work, interrupted by his death, was carried on by Freeman. Following a paper by Noon and Freeman, many other writers reported their experiences with polen-extract therapy.

In 1934 Harrison (1) published the results of experiments on guinea pigs with alum-precipitated pollen extracts. Guinea pigs were sensitized by injecting an aqueous extract of giant ragweed pollen, and then attempts were made to desensitize them with alum-precipitated pollen extract. Harrison found that alum-precipitated pollen extract was a more certain sensitizer than was the aqueous extract. He further found that alum up to 0.3 percent did not interfere with desensitization, but that alum in concentrations of 0.6 and 0.8 percent definitely retarded or prohibited desensitization. Caulfeild (2), in July 1936, published a report confirming that part of Harrison's experiment relating to alum-precipitated pollen extract being an efficient sensitizing agent. In the fall of 1934 Harrison suggested that we treat some of our hay-fever patients with alum-precipitated pollen extract and furnished the following formula for the manufacture of the extracts:

To one volume of the pollen add three volumes of ether; shake well, allow to settle, decant the supernatant ether, and discard. Repeat this operation three times. After the third extraction decant all ether possible and remove the remainder by evaporation in a warm (not hot) water bath. The pollen is now ready for extracting.

Extracting fluid

Solution no. 1:		
NaCl	grams	2.5
$NaHCO_3$	do	2.7
Aqua dist. (qs)	cubic centimeters	1,000.0
Solution no. 2:		
Solution no. 1	parts	55
Glycerin, C. P	do	45

Solution no. 2 is designated the extracting fluid and is filtered through a Berkefeld filter and tested for sterility.

Add two grams of pollen to every 100 cubic centimeters of extracting fluid. Allow this to stand for 10 to 14 days at room temperature with occasional shaking. It is now filtered, first through coarse filter paper to remove as much pollen debris as possible, then through a medium Berkefeld filter. The extract is tested for sterility by aerobic and anaerobic cultural methods.

We have been combining the various pollens from the spring grasses in one extract and the ragweed in another, as:

Spring type

	Gram
Orchard grass	1.00
Sweet vernal grass	.50
June grass	.50
Timothy	2.00
Redtop	.50
English plantain	.50
	5.00
	Cubic centimeters
Extracting fluid	250.00

Fall type

	Grams
Ragweed, common	2.0
Ragweed, giant	2.0
	4.0
	Cubic centimeters
Extracting fluid	200.0

The pollen of Bermuda grass, and, at times, any desired combination of other pollens, may be prepared as a separate extract for treatment of particular cases. This extract contains approximately 20,000 pollen units per cubic centimeter, the pollen unit in this instance having been arbitrarily chosen as the equivalent of 0.001 mgm of pollen based upon the amount of nitrogen per cubic centimeter as determined by the Kjeldahl method. Assuming that the finished extract contains 20,000 pollen units per cubic centimeter, the dilutions are made in the following manner:

10 cubic centimeters of 20,000 unit extract plus 10 cubic centimeters extracting fluid equals 10,000 units per cubic centimeter.

2 cubic centimeters of 20,000 unit extract plus 18 cubic centimeters extracting fluid equals 1,000 units per cubic centimeter.

0.2 Cubic centimeter of 20,000 unit extract plus 19.8 cubic centimeters of extracting fluid equals 100 units per cubic centimeter.

Prepare a 10-percent solution of potassium aluminum sulphate in distilled water. Filter through Berkefeld filter and test for sterility. This is added to the various dilutions of pollen extract so as to give 0.25 percent of alum.

Schedule of doses of alum-precipitated pollen extract as used at the U. S. Naval Medical School

Dose no.	Vial, units per cc	Amount in cc	Units	Dose no.	Vial, units per cc	Amount in cc	Units
1	100	0.05	5	8	10,000	0.035	350
2	100	.10	10	9	10,000	.07	700
3	100	.20	20	10	10,000	.135	1,350
4	1,000	.035	35	11	20,000	.13	2,600
5	1,000	.06	60	12	20,000	.25	5,000
6	1,000	.10	100	13	20,000	.30	6,000
7	1,000	.19	190				

The schedule of doses, as listed above, was agreed upon by Harrison and Lt. Comdr. F. M. Rohow, Medical Corps, United States Navy.

It is only a guide to treatment and must be varied according to the needs of the patient and whether or not reactions occur. The dose in cubic centimeters is very small so as to give a minimum amount of alum. The total amount of alum for a full course of spring and fall treatment is less than one-quarter gain, distributed over a period of several months so there is no danger of cumulative effects. We have not exceeded 2,600 units of the spring, and 6,000 units of the fall type, as a maximum dose, and have found this dosage sufficient to give complete relief in the majority of cases. In the District of Columbia we begin treatment for the spring type of hay fever about April 1. Treatments are given twice weekly until the maximum dose of 2,600 units is reached, after which treatment is given weekly until about the middle of June. In the case of fall hay fever, we start treatment about July 1; the injections are given biweekly until a dose of 6,000 units is reached, and thereafter treatment is given once a week until frost.

Due to the slower rate of absorption of alum-precipitated pollen extract, we expected to accomplish the following beneficial results by its use: (1) An increase in therapeutic efficiency due to the constant and even rate of utilization by the patient; (2) an abolition of constitutional reactions, or at least a reduction in frequency and severity; (3) a decrease in the number and frequency of treatments required. The first cases treated with alum-precipitated pollen extract received the initial treatment after the beginning of the hay-fever season in the fall of 1934 under the supervision of Rohow. There were only five of these cases, so the dosage, reactions, if any, and the results of the treatment will be given in detail.

Case 1.—Mrs. C. J. M. Complaint: Hay fever yearly, beginning on or about August 15 and continuing until after frost. Skin test gave the following reaction: Ragweed, common, 4 plus; ragweed, giant, 3 plus; and 4-plus reaction to the following grasses: Orchard, June, sweet vernal, timothy, and redtop. Patient denied having symptoms of hay fever in the spring and early summer. Treatment was begun with alum-precipitated ragweed pollen extract on August 10 and continued as follows:

Date	Unit of pollen per cc [1]	Amount in cc	Unit dose	Remarks
Aug. 10, 1934	100	0.05	5	Headache and local reaction lasting 24 hours.
Aug. 13, 1934	100	.15	15	No reaction.
Aug. 16, 1934	1,000	.04	40	Local reaction lasting 24 hours.
Aug. 20, 1934	1,000	.10	100	Do.
Aug. 23, 1934	1,000	.24	240	Do.
Aug. 27, 1934	10,000	.05	500	Do.
Aug. 30, 1934	10,000	.05	500	No reaction.
Sept. 4, 1934	10,000	.05	500	Do.
Sept. 8, 1934	10,000	.05	500	Do.
Sept. 10, 1934	10,000	.05	500	Do.
Sept. 17, 1934	10,000	.05	500	Do.
Oct. 1, 1934	10,000	.05	500	Do.
Oct. 8, 1934	10,000	.05	500	Do.

[1] 1 unit equals 0.001 mgm of pollen.

In this case not more than 500 pollen units were given as the maximum dose because treatment was started after the beginning of the hay-fever season. Although this patient had an occasional attack of sneezing, the treatment from her standpoint was highly successful.

Case 2.—Miss G. Du V. The usual history of hay fever was obtained. Skin test gave a 4-plus reaction to common ragweed; a 1-plus reaction to giant ragweed; 4 plus to redtop and timothy; and 3 plus to orchard grass. Treatment was started on August 11.

Date	Unit of pollen per cc.	Amount in cc.	Unit dose	Remarks
Aug. 11, 1934	100	0.05	5	Local reaction at site of injection lasting 24 hours.
Aug. 13, 1934	100	.15	15	Local reaction; 36 hours.
Aug. 16, 1934	1,000	.04	40	Do.
Aug. 20, 1934	1,000	.10	100	Do.
Aug. 23, 1934	1,000	.24	240	In addition to the local reaction patient developed hives which lasted about 3 hours.
Aug. 27, 1934	10,000	.05	500	Mild constitutional symptoms with hives rapidly subsiding.
Aug. 30, 1934	1,000	.24	240	No reaction.
Sept. 5, 1934	1,000	.24	240	Do.
Sept. 8, 1934	1,000	.24	240	Do.
Sept. 11, 1934	1,000	.24	240	Do.
Sept. 15, 1934	1,000	.24	240	Do.
Sept. 20, 1934	1,000	.24	240	Do.

Although this patient had a local reaction about the site of inoculation for the first six injections, and mild constitutional reactions with the fifth and sixth treatments, she obtained so much relief she desired to continue her treatment. Also, this patient requested treatment in the fall of 1935 and 1936, and had no further reactions. It is believed that the mild constitutional reactions in this case were the result of too rapid an increase in dosage or the time intervals were spaced too close together.

Case 3.—Mr. W. E. L. Gave a typical history of fall hay fever beginning about August 15. Skin tests gave 4-plus reactions to the common and the giant ragweed. There was no reaction to the spring grasses. Treatment with alum-precipitated pollen extra began on August 27, 1934.

Date	Unit of pollen per cc	Amount in cc	Unit dose	Remarks
Aug. 27, 1934	100	0.05	5	No reaction.
Aug. 30, 1934	100	.15	15	Do.
Sept. 4, 1934	1,000	.04	40	Do.
Sept. 6, 1934	1,000	.10	100	Do.
Sept. 10, 1934	1,000	.24	240	Do.
Sept. 13, 1934	10,000	.05	500	Do.
Sept. 17, 1934	10,000	.05	500	Do.
Sept. 20, 1934	10,000	.05	500	Do.
Sept. 25, 1934	10,000	.05	500	Do.
Sept. 27, 1934	10,000	.05	500	Do.

It will be noted that the season was well under way when treatment was begun and that the doses were administered at frequent intervals and with rapid increase in amount without reactions occurring. The patient experienced marked relief of symptoms.

Case 4.—Mr. P. R. Appeared for treatment September 6, 1934, with all the symptoms of hay fever present. Treatment with alum-precipitated ragweed extract was begun on day of reporting.

Date	Unit of pollen per cc	Amount in cc	Unit dose	Remarks
Sept. 6, 1934	100	0.05	5	No reaction.
Sept. 9, 1934	100	.15	15	Do.
Sept. 13, 1934	1,000	.04	40	Do.
Sept. 18, 1934	1,000	.10	100	Do.
Sept. 21, 1934	1,000	.24	240	Do.
Sept. 24, 1934	10,000	.05	500	Do.
Sept. 28, 1934	10,000	.05	500	Do.
Oct. 1, 1934	10,000	.05	500	Do.
Oct. 8, 1934	10,000	.05	500	Do.

Although this patient was suffering from hay fever before treatment was begun and had surpassed his threshold of tolerance from absorption from the mucous membranes, he gave no local or constitutional reactions even though the doses were increased rapidly and given at short intervals. The patient received marked relief from symptoms.

Case 5.—Miss H. P. This case was very similar to case no. 4. The treatment was begun on September 6, 1934, and ended October 8, 1934. There were neither local nor constitutional reactions. There was marked relief from symptoms. This patient has been treated with alum-precipitated pollen extracts of the spring and fall groups for the years 1935 and 1936, with complete relief.

As the results of treatment of these five cases were so satisfactory, even though treatment was not started until late in the season, we decided to use this preparation in the treatment of all our cases, both spring and fall types, for the season of 1935. The same formula was used for 1936. Many of our cases received treatment for both the spring and the fall type of hay fever during the seasons 1935 and 1936.

Table I shows the results of treatment with alum-precipitated pollen extract of some of our cases of the spring type and Table II the fall type.

The treatment in a number of cases was not completed, due to transfer, illness of some nature other than hay fever, etc., hence are not included in the report. Some of these patients were supplied with extract which was given at other hospitals or naval stations after they had left this locality. We have received some favorable individual reports from these patients, but no accurate follow-up data has been kept. In our series the following cases merit individual comment:

Case 6.—Mr. W. D. B. Tolerated the increase in doses as in table of doses without trouble until reaching 2,600 units on May 6. Within 30 minutes following the dose of 2,600 units the patient had a rather severe reaction characterized by lacrimation and itching of the conjunctivas, sneezing, rhinorrhea, and itching of the mucous membranes of the nose, tingling and itching of the body surface, and a typical asthmatic attack. Treated with adrenalin, with rapid disappearance of symptoms. Following the constitutional reaction, the next dose was reduced to 350 units and then gradually increased to 900 units and held at this dose for the remainder of the season.

TABLE 1.—*Hay fever treatment—Alum-precipitated pollen extracts*

SPRING GRASSES

[Season: May 10 to July 1]

Case No.	Preseasonal treatment (graduated doses)			Seasonal treatment (sustaining)			Reactions	Results
	Started treatment	Number of treatments	Total units	Maximum sustaining dose	Number of treatments	Total units		
1	Mar. 25, 1935	12	8,020	2,600	5	8,340	None	Good, even though treatment was irregular.
2	Mar. 28, 1935	12	6,770	2,600	5	10,500	do	Complete symptomatic relief up until time patient missed treatment.
3	Apr. 1, 1935	12	8,020	2,600	7	14,600	Local	Marked symptomatic relief. Dose reduced due to irregularity of treatment, June 13, 1935.
4	do	11	5,420	2,600	6	15,600	None	Complete symptomatic relief.
5	do	11	5,420	2,600	4	10,400	do	Do.
6 [1]	Apr. 2, 1935	12	5,770	900	8	6,100	Marked constitutional reaction May 6, 1935, with 2,600 units; dose reduced to 350 units, followed by gradually increasing doses.	Total relief of symptoms in city, but mild symptoms while in the country.
7	Apr. 10, 1935	10	2,820	2,600	7	19,800	None	Mild symptoms with 2,600 units. Symptom free with 3,000 units.
8 [1]	Apr. 12, 1935	10	1,490	2,600	6	11,750	Mild constitutional reaction with 20 units.	Complete symptomatic relief.
9 [1]	Mar. 10, 1936	18	12,962	2,600	5	13,000	Mild constitutional	Do.
10 [1]	Mar. 24, 1936	15	4,330	2,600	7	14,850	Asserted a local reaction but did not report it. Constitutional reaction with next dose.	Good.
11	Mar. 31, 1936	12	5,520	1,350	8	9,950	None	Complete symptomatic relief.
12	do	10	810	2,600	8	17,650	do	Complete symptomatic relief. Maximum dose reached May 22.
13	do	12	5,610	2,600	7	18,200	do	Complete symptomatic relief.
14 [1]	Apr. 3, 1936	12	4,520	2,600	6	15,600	Local reaction Apr. 28, 1936. Constitutional reaction May 8, 1936.	Do.
15	Apr. 13, 1936	8	440	2,600	7	10,550	None	Good, even though treatment was started rather late.
16	Apr. 14, 1936	9	1,470	2,600	7	16,950	do	Complete symptomatic relief.
17	Apr. 15, 1936	9	1,470	2,600	7	16,950	do	Do.
18	Apr. 21, 1936	7	420	2,600	7	12,800	do	Complete symptomatic relief. Maximum dose reached May 25.
19	do	7	420	2,600	9	18,000	do	Complete symptomatic relief. Maximum dose reached May 26.
20	May 1, 1936	4	70	500	13	4,900	do	Maximum dose reached June 5, 1936. Maintained at low level of 500 units because of late start. Complete symptomatic relief.

[1] Discussed in text.

TABLE 2.—*Hay fever treatment—Alum-precipitated pollen extracts*

RAGWEED

[Season: August 15 to frost]

Case No.	Preseasonal treatment (graduated doses)			Seasonal treatment (sustaining)			Reactions	Results
	Started treatment	Number of treatments	Total units	Maximum sustaining dose	Number of treatments	Total units		
21	July 1, 1935	11	5,420	5,000	11	61,600	None	Complete symptomatic relief. Maximum dose reached Aug. 22.
22	July 2, 1935	12	6,120	6,000	8	44,000	do	Complete symptomatic relief.
23	July 1, 1935	12	6,120	5,000	5	20,500	do	Complete symptomatic relief; irregular treatment.
24	do	13	16,420	6,000	9	44,600	do	Partial symptomatic relief; irregular treatment.
25	do	13	16,420	6,000	5	25,600	do	Patient failed to take treatment from Aug. 23 to Sept. 16. Had mild attacks during this time.
26	do	13	16,420	6,000	8	48,000	do	Complete symptomatic relief.
27 [1]	do	13	14,420	4,000	7	28,000	Mild reaction with 5,000 units	Good.
28	do	11	3,170	6,000	6	35,000	None	Do.
29	July 18, 1935	8	770	6,000	10	45,650	do	Complete symptomatic relief; maximum dose reached Aug. 29.
30	July 8, 1935	7	290	5,000	10	30,190	do	Complete symptomatic relief. Had only reached 190 units at the beginning of season. Doses increased by schedule to 5,000 units.
31	Aug. 1, 1935	4	70	6,000	11	28,350	do	Complete symptomatic relief. Although patient had only reached 60 units at the beginning of season he was able to tolerate usual increase to 6,000 units.
32	June 30, 1936	10	930	3,000	14	33,800	do	Irregular preseasonal treatment. Attained 350 units at beginning of season. A maximum dosage of 3,000 units administered biweekly.
33 [1]	July 3, 1936	13	9,420	6,000	9	47,000	Mild constitutional reaction with 2,000 units; and another with 4,000 units.	Complete symptomatic relief.

[1] Discussed in text.

TABLE 2.—*Hay fever treatment—Alum-precipitated pollen extracts*—Continued

RAGWEED—Continued

[Season: August 15 to frost]

Case No.	Preseasonal treatment (graduated doses)			Seasonal treatment (sustaining)			Reactions	Results
	Started treatment	Number of treatments	Total units	Maximum sustaining dose	Number of treatments	Total units		
31	July 22, 1936	8	770	2,000	10	13,400	None	Had attained 350 units at beginning of season. Had mild symptoms with 2,000 units at height of season. Sustaining dose reduced to 1,500 units, biweekly. Complete symptomatic relief other than noted.
35	July 7, 1936	12	7,820	6,000	8	47,000	do	Complete symptomatic relief.
36	do	11	3,370	2,000	9	17,600	do	Good. Had very mild symptoms with 2,000 units. Received almost complete relief except in rural sections.
37 [1]	July 3, 1936	12	2,480	1,800	13	21,850		This case discussed in detail in text.
38	June 30, 1936	13	16,420	6,000	7	40,000	None	Complete symptomatic relief.
39	do	14	11,000	6,000	7	41,000	Constitutional reaction on Aug. 7, on reaching 2,600 units. Dropped back to 2,000 units and then gradually increased to 6,000 units without reaction.	Do.
40	do	14	9,000	5,000	11	56,000	Mild constitutional reaction when 6,000 units reached. Dropped back to 5,000 units and continued at that level without reaction.	Do.

[1] Discussed in text.

Case 8.—Miss H. P. (same as case 5 of 1934 series). Had a mild constitutional reaction on April 19 following a 20-unit dose. The 20-unit dose was repeated on April 23 without symptoms, after which the regular increases were given without producing reactions. It is believed that the reaction in this case was due to the accidental injury to a blood vessel or lymph channel, causing a too rapid absorption of the pollen extract.

Case 9.—Mrs. A. G. H. Suffered with "rose cold" every spring since a girl. Skin tests gave marked reactions to June grass, lamb's-quarters, orchard grass, plantain, redtop, sweet vernal grass, and timothy. Negative reactions were obtained to all the tree pollens and a moderate reaction to both ragweeds. Treatment with pollen extract (not alum-precipitated) on two previous occasions without benefit. Had ionization (or iontophoresis) of nasal mucosa in France, with slight improvement for the remainder of the season.

This patient was markedly sensitive, as shown by violent skin reactions occurring within 2 minutes by the scratch method. Treatment was started with alum-precipitated pollen extract 20 days earlier than usual. This early start was made in order that a more gradual increase of dosage could be given, yet giving sufficient time to reach the maximum dose before the beginning of the hay-fever season.

She tolerated the gradual increase without even a local reaction, and there was no reaction of any kind until May 29, when she had a mild constitutional reaction following the twenty-first dose. She reached the maximum of 2,600 pollen units on May 4, after which date she received three doses of 2,600 units without trouble, but on the fourth dose of 2,600 units the reaction occurred. It is believed that this reaction was precipitated by overfatigue, for the patient had been very busy the week preceding superintending the storage of her household effects. The following doses were not reduced and were tolerated by the patient without ill effects.

Case 10.—Mr. J. W. This patient was one of those extremely sensitive individuals, so the initial dose was 2.5 pollen units instead of the usual 5 units. The increases were more gradual than in the table of doses. Following the 60-unit dose the patient asked that he be given a certificate requesting that he be excused from gym classes, as the exercise made his arm quite red and painful. Thinking probably the symptoms were exaggerated, the request was not granted. Three days after the 60-unit dose he was given 100 units, and again he complained of a sore arm. The next dose, 190 units, produced a mild constitutional reaction, and it was realized that the patient was not exaggerating his sore arm. He was excused from gym class and treatment continued. On reaching 1,200 units, patient again complained of a red and painful arm, so this dose was repeated a second and third time, then the doses gradually increased.

Case 14.—Mrs. D. B. B. This patient suffered a local reaction with 350 pollen units. This dose was repeated, followed by a more gradual increase. On May 8 the patient received 1,200 units, and within 30 minutes had a mild constitutional reaction. She next received 1,500 units, then 2,600 units for the remainder of the season without reactions.

Case 27.—Mrs. P. A very mild constitutional reaction with 5,000 units occurred on August 8. The dose was then reduced to 4,000 units, given at weekly intervals, without further reaction.

Case 33.—Mr. P. B. On August 8 there was a mild constitutional reaction with 2,600 pollen units. The dose of 2,000 pollen units was repeated on August 11 without reaction. On August 18 the patient again had an extremely mild constitutional reaction, consisting of a tickling sensation in the nose and throat,

with an increase of nasal secretions, with a dose of 4,000 units. The 4,000-unit dose was repeated, then doses were increased by 500 units per dose until the maximum of 6,000 units was reached.

Case 37.—Miss E. S. Had a mild constitutional reaction with 1,000 units on August 14, consisting of a hacking cough and general itching of the body. The patient stated that the cough was due to a tickling sensation in the chest. Hives and urticaria were absent. Symptoms subsided within 1 hour without treatment. The dose of 1,000 units was repeated August 18, 21, and 25 without recurrence of symptoms. Following this, the dose was gradually increased and reached 2,000 units on September 8, at which time the patient again had the same type of reaction as described above, except that on this occasion hives appeared over chest and neck. No treatment was necessary. On September 11 she received 2,000 units and on September 15, 1,900 units; and each time a milder reaction occurred. Thereafter, 1,800 units were given without reaction.

In this case the dose of alum-precipitated pollen extract plus the absorption from the mucous membranes surpassed the patient's tolerance, producing the reactions. Even though this patient received comparatively small doses of alum-precipitated pollen extract, she had only an occasional attack of tickling of the mucous membranes of the nose and throat followed by sneezing. She was highly pleased with the results of the treatment.

While the treatment of hay fever with alum-precipitated pollen extract leaves much to be desired, it gives better results in our hands, in the short series of cases treated by this method, than with the non-alum-precipitated extracts. The patients rarely complain of pain or discomfort around the site of injection. Constitutional reactions are mild, as a rule, when they occur at all. In our series of 96 cases we have had only 2 severe reactions, both readily controlled by adrenalin.

The patients have experienced greater freedom from symptoms; in fact, most of them were entirely relieved. Even those cases starting treatment late in the season, after the appearance of symptoms, obtained almost complete relief.

SUMMARY

1. A method of treating hay fever by alum-precipitated pollen extract is described.

2. The rationale of this method and its probable results are discussed.

3. Case histories are reported.

CONCLUSIONS

1. In our hands, this method of treatment has given decidedly better results, so far as the relief of symptoms is concerned, than has the non-alum-precipitated pollen extract.

2. Constitutional reactions were reduced in frequency and severity.

3. The number of treatments necessary to control symptoms were reduced in some cases but not in all.

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MALARIA

By W. H. MICHAEL, Commander, Medical Corps, United States Navy

Two fallacies are rooted in the minds of a majority of the population and of a considerable portion of the medical profession: first, that malaria equals chills and fever; second, that the diagnosis of malaria is not difficult.

Eight consecutive cases of malaria were sent to a naval hospital by naval medical officers, that is, by physicians who have more than the average experience with that disease. Five of these were diagnosed, catarrhal fever acute; one, migrane; one, fever, cause undetermined; and only one, diagnosis undetermined, malaria.

Of course these diagnoses were made hurriedly in the course of large routine sick-calls. Confronted by acute symptoms, the doctors rightfully considered hospitalization more important than diagnosis. However, this did occur in a district where malaria is known to be common.

During the same period as the above admissions, two non-naval cases came in who were treating themselves with chill tonic. Neither had malaria. One had syphilis and the other, who had taken chill tonic for 6 months, soon died with acute nephritis. Necropsy showed no malaria.

More recently a case was sent in by a civilian physician with the positive diagnosis of malaria. The case had received intravenous quinine. Thick smears were negative and remained so. He proved to have an appendiceal abscess—hence his chills and fever.

Failure in the diagnosis of malaria accurately is not limited to the present generation. The writer recalls spending two uncomfortable days in a Canal Zone hospital (1913) before his case was diagnosed by himself. Several thin smears had been reported negative.

Malaria, like the gamut of diseases, is diagnosed by: history, subjective symptoms, physical findings, and most conclusive of all, laboratory examination.

History alone may clinch the diagnosis. In a patient exposed at night in a malarious district malaria must either be determined or excluded. Frequently, week-end camps, night bathing parties, or a stalled automobile will fix both the time and place of infection. In Port au Prince, Haiti, many cases among the white foreign population could be traced directly to open air dinner parties on a picturesque but badly infected hotel terrace which overhangs the bay.

Subjective symptoms may be conclusive or misleading. The so-called typical every-other-day chill is not the rule, but when it occurs it makes the diagnosis. However, urinary chills are frequent and may simulate a double tertian infection, and a chill may be the first symptom in almost any of the acute infections from erysipelas to typhoid fever.

The more important and constant subjective symptoms are: headache, general malaise, nausea, and fever; and these usually occur without cough or other localized infections to account for them.

But neither does another disease exclude malaria, nor does malaria exclude another disease. The most beautiful malarial blood smear that the writer ever saw, was taken from a convalescent pneumonia; and his most embarrassing moment was when his chief of service pulled down the bedclothes from a malaria patient and uncovered syphilitic leg ulcers.

Physical findings indicating malaria are rather the exception in active military service. They are: a large spleen, anemia, and a subicteric tint. These can only be expected in chronic cases. One palpable spleen was found in the 15 cases which inspired these notes. He was a war veteran who had been treating himself intermittently for 6 months, incidently, with both quinine and atabrine.

Beware of the supposed pneumonia with a comparatively low pulse rate and slow respiration, with a "central" lung envolvement, and low white count. Who among those who have practiced in the Tropics cannot recall acquaintances who have gone to the States on summer vacation and have not come back? Pneumonia is so often the official diagnosis. If questioned, sometimes a relative will answer: "No, his chest did not seem to hurt a great deal and he hardly coughed at all."

Laboratory examination would save many of these. The examination of a thick smear of the patient's blood is the only sure way to diagnosis malaria. If he has acute symptoms due to malaria, the experienced eye will find parasites in two thick smears. If no parasites are found in two thick smears, there is no reason to treat the case for malaria. Experience has proved the thick smear 32 times more effective than the thin smear. The thin smear has the advantage of rapidity of preparation, but a negative is not conclusive.

When the diagnosis of malaria is made in a case, the most pressing thing is to find the mosquitoes that infected him and kill them if possible. If the history points to infection in his home or in military barracks, the mosquitoes are probably still in the building. Look for them under and behind the bed, in the closets, dark corners, and in the early morning inspect the screens.

From this point the strategy of mosquito war would lead too far afield, and perhaps, divert too much attention from the next important procedure: Find the humans who infected the mosquitoes. They,

too, are probably in the house. If that house is a military barrack, beware. If not in the house, they are close neighbors. Suspect particularly the colored neighbor. If white and truthful, the malaria carrier will give a history of headache, fever, or even chills. If colored, supplement the history with a search for a spleen. A thick smear will do the rest. One of the most astounding common breaches of hygiene on expeditionary duty in the Tropics, is the custom of enforcing the use of mosquito nets by all camp personnel except the malaria infected native camp follower. Moreover, it is a waste of time to cure the patient and send him back to be infected again.

When this small epidemic of malaria appeared, the writer was befuddled by a mass of contradictory propaganda. Further complicating the situation was the recent death of a malaria patient treated with atabrine. No autopsy was obtainable. Post hoc may not be propter hoc; nevertheless, the routine treatment adopted reserved that drug for those cases who reacted badly to quinine. According to recent literature individuals sensitive to quinine are more common. None occurred in the present series and not a dozen have been observed in 7 years of tropical service.

Ten grains of quinine sulphate were given three times a day for 7 days. No acid was given because it is unnecessary and increases the tendency to nausea. During the last 3 days of these 7 days, the patients received one-sixth grain of plasmochin three times a day in addition to the quinine.

There were some exceptions to this routine: In a heavy malignant infection, the treatment was begun with 0.7 gram of quinine hydrochlorosulphate and 100 grams of glucose in a liter of salt solution. Reaction was excellent. This case and another continued to receive quinine intravenously until they could tolerate it by mouth. The above routine of treatment was repeated after 4 days rest in one case, because parasites were still present after the regular course.

One case relapsed. On his first admission he showed a mixed infection with many sexual forms of both *P. falciparum* and *P. vivax.* All, including the relapsed case, have been returned to duty for several months.

After having undergone the old Canal Zone treatment (liquid quinine for 6 weeks) the writer confesses enthusiasm for the results in this very small series which was treated (with an exception) for only one-sixth of the time. The chances of blackwater fever or other complications should be greatly reduced by the adoption of the short course, while 1 relapse in 15 cases would be expected even after the Canal Zone treatment.

BARBITURATE POISONING

A Review with Report of Two Cases [1]

By F. L. McDaniel, Commander, Medical Corps, United States Navy, and Robert A. Bell, Lieutenant, Medical Corps, United States Navy

In preparing this paper the temptation has been great to wander afield and discuss allied topics. In selecting and discarding from the mass of literature it has been a problem to decide what to accept and what to discard. We have tried not to commit the error, as the British say, of throwing out the baby with the bath.

The most common hypnotics of today belong to the barbituric acid group. Introduced about 30 years ago by Fisher and Von Mering (1), who established that barbituric acid, a derivative of urea and malonic acid, while physiologically relatively inactive in itself, could, by replacement of two hydrogen atoms with ethyl radicals, be made into a powerful hypnotic for both animals and man. The use of these derivatives therapeutically dates a little over 20 years ago. The first one extensively used was veronal. There is now a long list of preparations put out under different trade names and sold directly to the public. Their use is becoming more and more popular with the laity. If some check is not instituted these drugs may run a close race with aspirin as a popular form of self-medication.

In the field of mental study the patient is questioned very closely about drug habits and it is astonishing to learn how widespread the use of the barbituric acid derivaties is becoming. It is the favorite medication of the restless and emotionally unstable, of the worried, the weary, and the jaded, and of chronic drunks to temper the natural physiological reactions of the morning after.

As a rule the fatal dose of the barbiturates averages about 15 to 30 times the therapeutic dose. Clinically and experimentally this ratio has been found to vary greatly. As pointed out by Weiss (3), pain, sympathetic excitement, worry, and fever act antagonistically to the effect of the barbiturates; whereas anemia (4) and cerebral depression are synergistic, making the patient more susceptible to their depressant effect. Since the liver detoxifies the unsaturated barbiturates and the kidneys excrete the saturated series, disease of these organs accentuates and prolongs the effect of any given dose. Inactivation or elimination of the drug requires an efficient circulation; hence in cardiac failure, shock or collapse, narcosis is usually prolonged. An idiosyncrasy to the drug may cause toxic manifestations as confusion, psychotic or dermal reactions, although such symptoms are usually seen only after excessive dosage.

The most popular of the barbiturates, both with the profession and the laity, is the amytal group. It shows the largest interval

[1] This paper was presented at staff conference, U. S. Naval Medical Center, April 2, 1937, by the senior author.

between the lethal and the effective dose in animal tests. Sodium amytal, the sodium salt of iso-amyl-ethyl barbituric acid was prepared and used in animals experimentally in 1926 (2). Its intravenous use in 350 psychotic patients has been reported by Lorenz, Reese, and Washburne (5), who found that an average dose of 9½ grains was required to obtain complete narcosis. The functional group required somewhat more than the organic group. You will see later that one of our patients took 13 times this amount with recovery. The anesthetic dose of the drug is about 50 to 70 percent of the so-called fatal dose and 23 to 37 percent of the fatal dose (3) is required to produce sleep, moderate muscular relaxation, and partial anesthesia. Instances of fatalities from very moderate doses are recorded. In one case reported (6) a patient being prepared for thyroid operation was given 7½ grains of nembutal in divided doses, 1½ grains at night and 6 grains in the morning; fatal poisoning resulted. Hyperthyroidism, renal or hepatic deficiency make the patient very susceptible. This same article reports a patient who took 475 grains of assorted barbiturates and the fact was not discovered for 14 hours, so that the drug had become well absorbed. He recovered, after very vigorous treatment, with apparently no serious after effects. This patient developed numerous urticurial blisters around the arms, wrists, and chest 12 or 14 hours after the drug was taken. In our case (R. O.) a marked urticurial reaction with blister formation and ulceration appeared in the right auricle.

A point not given the attention it deserves and of special interest from the medico-legal aspect and in the Navy is the question of deciding upon misconduct and line of duty. Weiss (7) warns of this and Dr. Richards, lecturer on forensic medicine in the University of Aberdeen, Scotland, records several cases which have come to his attention and which he labels "barbituric acid automatism." It occurs among habitual users of barbital derivatives who usually keep a supply at their bedside. Apparently after one or two tablets a normal narcosis develops and while still unconscious they automatically continue to take additional tablets. Should the patient take a fatal dose in this manner the obvious conclusion upon finding the body would be suicide.

The general action of these hypnotics is to produce a descending depression of the central nervous system beginning with the cortex. It has been found that individual compounds act at slightly different levels and some exhibit earlier subcortical action than others. As the dosage is increased the depression deepens and gradually the action on the medullary or vital centers supervenes. This is usually first manifested by respiratory center depression. Some authorities say that cardiac depression is paramount but apparently paralysis of respiration is the most prominent symptom. In overdosage with

other hypnotics, as chloral hydrate and paraldehyde, circulatory collapse may occur initially and the onset may be sudden and dramatic. Experimental work in pharmacology indicates that we may divide the barbiturates into three classifications.

1. *In order of increasing toxicity.*—Barbital, dional, dial, amytal, pheno-barbital, allonal.

2. *In order of increasing efficiency.*—Barbital, pheno-barbital, dional, dial, amytal, allonal.

3. *In order of increasing margin of safety.*—Phenol-barbital, barbital, allonal, amytal, dial, dional.

Most of these compounds are produced by varying the alkyl group of radicals. It has been found that by lengthening the chain of alkyl groups the toxicity is decreased. The toxic effects from the use of the barbiturates are most often the result of taking an overdose with suicidal intent or from the indiscriminate administration for the induction of anesthesia. Adequate warning has been sounded against the latter (8) (9), and while the former is increasing in popularity it still ranks rather low in the list of drug suicidal agents, being about eighth in the list for the United Kingdom (9a).

The barbiturates taken orally are absorbed in from 15 to 60 minutes. Toxic manifestations may be delayed since nausea may induce pyloric spasm and slow absorption. Early hypnosis is attended by a feeling of extreme well-being and serenity, a sense of warmth and genial friendship towards the world in general. Fears and apprehensions vanish. Hallucinations do not seem to occur. There is no dream state. Pain is absent. As absorption increases the depression deepens, coma supervenes, and consciousness is lost in about 15 to 20 minutes. The pupils become constricted, contrary to the commonly held idea that in poisoning with this drug the pupils are dilated, and that it can thus be readily differentiated from opium poisoning. In the cases we have seen the pupils are always moderately contracted, some very much so, and light reaction is absent. The respiration becomes slow and shallow, the pulse feeble but not especially rapid, and there is a pronounced fall in the blood pressure and body temperature, though the latter may be elevated (10). Frequently there is suppression of the urine and retention may occur. Occasionally convulsive seizures occur, probably due to cerebral edema. The reflexes are usually absent in the deep stages. The fall in blood pressure is not as striking in narcosis with sodium amytal as with chloral hydrate or paraldehyde, but when it occurs the systolic falls more in proportion than the diastolic. There is increased capillary permeability with swelling of the eyelids, lips, cheeks, and ears, erythema, urticaria, blebs and other exudative and even ulcerative skin lesions. Localized areas of edema may develop and edema of the lungs is an expected complication which predisposes

to convalescent bronchopneumonia. The blood chemistry shows no change of blood sugar; there is a fall in calcium content and an increase in the CO_2 tension. The hydrogen ion concentration is ncreased.

Renal function shows a diminution of output without impairment of glomerular activity as shown by the phenosulphophthalein excretion. Liver function shows little change. Few observations have been made on the gastrointestinal tract. There appears to be no decrease in the tonus or amplitude of contraction of the small intestines.

Neurologically, we have mentioned the disturbances of the pupillary reflex. Just before narcosis sets in the patient may show evidence of vertigo, a staggering gait, and diplopia. Individuals picked up on the street by the police may present a typical picture of inebriation. In the case of one patient who had been taking veronal, and was admitted to this hospital, a vigorous but unsuccessful effort was made to get a positive Bogan's reaction. The speech is thick and as narcosis proceeds there is a very decided tendency for the tongue to fall back into the pharnyx. This was a particularly troublesome factor in the cases reported below. It is a grave development which must be relieved, and ranks in seriousness with loss of the pharyngeal reflex.

The pathological findings have been determined chiefly through experimental pharmacology. There is congestion of the brain, considerable perivascular edema, and small scattered hemorrhages. Histologic changes are present in the cortex especially in the deeper cell layers. The Nissl bodies tend to disappear. The cortical cells show degeneration of the cell membranes and nuclei. The entire brain shows degenerative changes with cellular damage which seems to be due to the direct action of the drug rather than secondary to a disturbed circulation. The lungs are always congested and many authorities feel that there is a direct toxic action of the drug on the lung tissue itself. Bronchopneumonia and pulmonary edema dependent upon prolonged coma, increased capillary permeability, and circulatory collapse, are frequent complications often responsible for death. In the kidney most of the damage is seen in the convoluted tubules, less in the glomeruli. In the liver we observe fatty degeneration, especially of the central portion of the lobules.

In diagnosis Weiss (4) states, "The differences in behavior of patients intoxicated with various types of hypnotics are inadequate for the clinical diagnosis of the nature of the poisoning." He says that the diagnosis should always be determined through circumstantial evidence and the finding of the barbiturate in the excretion of the patient. We now have a very prompt and reliable method [1] for detec-

[1] H. Oettel, Arch. Pharm. 1:10, 1936.

tion of the barbiturates and this should be made use of in all cases of suspected poisoning with hypnotic drugs.

In the treatment of the acute poisoning with the barbiturates, we recognize two stages, that of coma and that of reaction. Energetic therapy is essential in early coma. The method of attack can be reduced to three fundamental procedures. Firstly: Attempt to eliminate the drug from the body either before or after absorption. Secondly: To combat the action of the drug, which has already been absorbed, by antagonistic drugs and supportive therapy. Thirdly: To prevent the onset of complications and combat any untoward after effects. Unfortunately most of these cases are first discovered after the drug has been absorbed from the alimentary canal. It is, however, always well to do a gastric lavage and after the stomach has been thoroughly washed to introduce 60 cubic centimeters of a saturated solution of magnesium sulphate. Do not remove the tube but allow it to remain for continuous drainage because gastric juice as secreted is saturated with the barbiturate and drainage constitutes an easy method of drug removal. Patient may be fed through the tube and aspiration of vomitus is prevented by its use. The barbiturates not detoxified by the liver are principally excreted through the kidneys (4) and in smaller percentages in the following order according to Koppanyi, Murphy, and Krop (11): Dial, neonal, phenobarbital, pernocton, and amytal. They report on the excretion of barbital in dogs and were able to confirm previously reported work by recovering in the urine from 42 to 91 percent of the dose administered. In the lowest output, that of 42 percent, it was revealed at autopsy that the animal had infarcts of the kidneys. These investigators found, also, that recovery from experimental barbital poisoning closely paralleled the amount excreted in the urine, and that the rate and percentage of total excretion did not vary with the size of the dose. They further found that recovery was not influenced by increasing diuresis with dextrose and conclude that maintainance of normal kidney functions, and not diuretic measures, are necessary for shortening time of recovery from coma due to those barbiturates eliminated primarily by urinary excretion. Previously reported work (12) (13) (14) (15) has emphasized the value of diuretic measures, especially with saline solution intravenously. Diuresis should be adequate and continuous without overtaxing cardiac or renal function. Moderate prolonged stimulation of renal function should be a chief aim of therapy in acute barbiturate poisoning. Diuresis may be aided by repeated phleboclysis using glucose and saline solutions to add calories and replace the chloride lost through gastric aspiration and perspiration. Damaging the kidneys or removing one kidney increases the toxic effect of the drug. It is reported (11) that amytal is recovered from the urine in only small amounts. Neither amytal nor neonal are excreted as such

in the urine (16) and (20a). We recovered from the urine considerable quantities of a substance giving a positive test for the barbiturates (case 2, amytal poisoning). We may also recover barbiturates from gastric contents, saliva, sweat, cerebrospinal fluid and from most of the organs and body tissues. It has been found that the concentration of barbital in the cerebrospinal fluid and the saliva is about the same as in the blood plasma. The concentration of barbital in the blood during the first 2 hours shows a sharp decline and then a very slow drop. The first is due to fixation by the organs, and the second to renal elimination. In bilaterally nephrectomized dogs the second decline does not take place. Spinal fluid drainage is recommended (17) (18). We found no case reports in which forced spinal fluid drainage had been given. Since the concentration of drug in the cerebrospinal fluid is about the same as in blood plasma (19) and low in comparison with that in the urine, this procedure would not seem especially indicated.

There are no chemical antidotes for acute poisoning with barbiturates. Pharmacodynamically antagonistic drugs are used and should be given in large doses. Since the barbiturates act upon the subcortical centers in the mid-brain, drugs which simulate these areas are employed. Among these used are caffeine, strychnine, coramine, brucine, cocaine, physostigmine, ephedrine, calcium gluconate, pictrotoxin, benzedrine, and insulin. All of these have been used with reported favorable results, in many cases the reasoning was *post hoc ergo propter hoc*.

The motor depressant, antispasmodic and peripheral action of physostigmine seem to render it unessential and probably harmful. Since amytal in anesthetic dosage inhibits the action of the vagus (20) atropine is contraindicated. The use of cocaine appears to add insult to injury and calcium gluconate is not essential. There is no definite indication for using insulin. The use of brucine, less active than strychnine, has no advantage over the latter, used experimentally (21) to save animals given three times the fatal dose of phenobarbital, sodium. Strychnine excites the ventral horn cells of the spinal cord lowering the threshold for stimuli; and in view of this site of action its use has been condemned (22). A definite and therapeutically valuable antagonism does exist as demonstrated by its use in the case (23) of a young woman who ingested 17 grams of barital (veronal) and 10 hours later was given strychnine in does of 10 milligrams every hour or two to a total of 0.39 gram in the following 60 hours. The smallest lethal dose of strychnine for a normal person is 30 milligrams. It has been used successfully by Weiss (4) in dosage of 10 milligrams hourly, and by others (24).

The use of ephedrine which stimulates the respiratory center (32) and counteracts sleep by stimulation of subcortical centers, appears

sound and is beneficial experimentally (26) and therapeutically (26b). Use of benzedrine, which has greater central and less peripheral action is also indicated. Ephedrine should be particularly valuable in these cases with vasomotor collapse, rapid pulse, low blood pressure and urinary suppression. It is in these cases that camphor and caffeine are especially useful; for while they fail to improve cases profoundly hypnotic they do have a beneficial effect on the circulation.

The hypnotic antagonist pyridine, beta-carbonic acid diethylamide, synthesized by Hartman, studied pharmacologically by Faust and Uhlman, and introduced in therapeutics by Thannhauser and Naunenbruck over 12 years ago, is known under the trade name of coramin. It has been studied extensively on the Continent, more recently in this country. Its use was initiated in 1892 by Koppen while studying the relatively new drug coramyrtin. Its action, pharmacological not chemical, effects the medulla and diencephalon, stimulating the respiratory, motor, coughing and vomiting centers. It causes yawning, salivation, and bronchial relaxation with increased secretion and expectoration. Respiration is particularly stimulated both in rate and depth. The cardiac excursions and blood flow are increased. Toxicity is low, cumulative effects absent, and action evanescent (26). The depth and duration of sleep are diminished and the drug is capable of improving respiration when the depression is so deep as not to respond to carbon dioxide. Once improvement occurs the center will then respond to carbon dioxide. It is less useful in amytal hypnosis (26). The usual dosage is 5 cubic centimeters intravenously every 5 or 10 minutes. Untoward effects are hiccough, vomiting, and flushing of the skin but they are not alarming. It has recently been reported upon favorably (27) in a large series of cases.

In action cardiazol resembles and is considered superior to coramin by continental workers (28) (29) but it causes convulsions in larger doses (26a).

The respiratory effect of alpha-lobelin is brief. It is a cardiac depressant. Its emetic, respiratory and vasomotor effects are similar to those of nicotine. Even in Europe, where it was used extensively, it is giving way to inhalational treatment which is safer and more efficient (30).

The respiratory depression in barbiturate narcosis is so refractory to the normal stimulus, carbon dioxide, that doubt has arisen whether it really plays a major role in the regulation of respiration. Its antidotal effect is minimal. Oxygen exchange and cellular metabolism are at a low ebb. Breathing continues mainly under the influence of anoxia. The administration of oxygen, by removing this stimulus, may induce fatal apnea (39). The oxygen is needed, however, and should be supplied in a carbon dioxide-oxygen mixture.

There is frequent failure of therapeusis in employment of all these analeptics. This is explainable by the observation (31) that in increasing narcosis the analeptic effects of epinephrine, caffeine, strychnine, cardiozol (mitrazol), coramine and strophanthin diminish, and finally cease; and in deep narcosis they impair the circulation and respiration in the rabbit. In the neutral poisonous principle of the fish berry, Cocculus indicus, discovered by Boulay in 1812, we have a medullary and autonomic center stimulant apparently superior to those mentioned above. This drug is very poisonous in large doses causing clonic convulsions. Its favorable effect on barbiturate narcosis in rabbits and dogs (33) (34) and in humans (26b) (35), led Lilly & Co. to market it in ampoules containing 1/100 grain each. It can be administered orally, subcutaneously, intramuscularly or intravenously. If the narcosis be from a quickly absorbed barbiturate as pentobarbital, pernocton, amytal, alurate or evipal, a single large dose, 1 or 2 cubic centimeters of the Lilly preparation, may be given intravenously in a person weighing 150 pounds. If there are no toxic symptoms such as twitching of the arms, unduly increased respiratory rate, or rise in blood pressure, the dose should be repeated in 20 minutes. As the patient improves the drug can be given orally in 3-milligram doses as needed. It is useful in chronic poisoning to detoxicate the patient. In view of the incomplete knowledge and poisonous nature of this drug it has been withdrawn from the market (36). However the Council on Pharmacy and Chemistry of the A. M. A.[1] (37) and others (38) have recently reemphasized the value and limitations of picrotoxin.

The untoward effects of the prolonged barbiturate narcosis are frequently responsible for the fatality. The indications for therapy are definite. The respiratory failure, as noted above, being characteristically refractory to carbon dioxide-oxygen, some other medullary stimulant is essential. The patient must be kept warm and adequate fluids administered. Continuous gastric suction and suction removal of secretions which collect in the pharynx, prevent aspiration pneumonia and interference with free respiration. The tongue must be prevented from falling back and thereby strangling the patient. The body tonus as a whole is lowered; and in conjunction with the central vasomotor depression, favors the development of bronchopneumonia and circulatory collapse. It is here that ephedrine, through its central stimulative effect and peripheral circulatory support, and strychnine, by increasing general body tonus, find their chief indication and usefulness. Camphor and caffeine are likewise useful, caffeine as coffee introduced into the stomach, or caffeine sodiobenzoate, 7.5 grains subcutaneously, may be repeated at 30-minute intervals. It is such measures, aided by frequent changes in position

[1] The Council on Pharmacy and Chemistry while recognizing its probable value, felt the drug should not yet be distributed to the general practitioner.

which increase body tonus, which ward off or minimize circulatory collapse, cause full inflation of the lungs and which prevent pulmonary oedema, atelectasis and bronchopneumonia. Catheterization when necessary and protective ointment to eyes, lips and mouth are obvious indications.

With this review in mind two recently followed cases are presented.

Case 1.—W. K. K., storekeeper second class, U. S. S. *Relief.* (Seen by F. L. McD.). This patient had caused no previous suspicion as to his mental condition or any drug habit. He was on duty on the vessel and one afternoon was found asleep in his bunk by a shipmate. He did not turn to at the usual hour next morning but was apparently in a state of coma with stertorous breathing, labored in type, and was thought to be drunk. As he slept in a small compartment with one or two other shipmates who were his friends, they decided to "cover him up" and allow him to "sleep it off" thinking to arouse him later in the day. When they attempted to arouse him for noon mess he was more comatose and was immediately taken to the medical ward. An abstract of the medical history follows: Diagnosis: Poisoning acute, barbital, classification A. 1. Within command. 2. Not work. 3. Due to own negligence or misconduct. 4. Used barbital (veronal) in excess, self-administered. Admitted at 11:30 a. m., from his bunk. An ordinary tablet bottle was found on his person and he is reported to have purchased veronal tablets a few days ago. Dose estimated at 2 dozen 5-grain tablets or 120 grains.

Physical examination.—Patient comatose. The face is flushed or slightly cyanotic. The breathing noisy and the flaccid tongue tends to obstruct the passage. (This is mentioned in the literature as a very common symptom of barbiturate poisoning.) Pupils equal, 3 millimeters in diameter, react slowly to light. Eye grounds—no gross abnormality. No evidence of corrosive poisoning in the mouth or odor of alcoholic liquors on the breath. Blood pressure, 105/75; pulse, 90 to 100. No abnormal sounds noted. Some moist rales heard over the bronchi. Abdomen negative except bladder distended, 900 cubic centimeters of clear urine obtained by catheter. The deep reflexes of arms were sluggish and the right knee jerk very sluggish. The superficial reflexes not elicited.

Impression.—Barbital poisoning.

Treatment.—Gastric lavage, 2 ounces of magnesium sulphate left in stomach. I do not recall that strychnine was given in this case. Caffeine-sodium-benzoate and coramin were given freely. The respiration became more shallow and superficial, cyanosis appeared, and he was placed in an oxygen tent. Pulse became more rapid, 110 to 120, and the patient died at 11:50 p. m.

Laboratory findings.—Urine positive for barbiturates.

Autopsy findings.—Edema and congestion with stasis of the lungs. Congestion and venous stasis in the solid viscera with acute degeneration due to the chemical (barbital). Moderate dilatation of right heart, mainly the auricle. Petechial punctiform hemorrhage in the serous cavities. Cause of death—poisoning, acute, barbital. The diagnosis was considered substantiated by the history, the physical findings, the clinical course, the presence of a barbituric acid derivative in the urine, and the autopsy findings.

COMMENT

This patient took an undetermined amount of veronal—approximately twenty-four 5-grain tablets. (About the same amount as that (amytal) taken by our second case). Treatment was started about 18 to 20 hours after taking drug. When seen he was in fairly good condition except for evidence of failing respiration. He did not respond to any

treatment, including gastric lavage with injection of magnesium sulphate, coramine and caffeine-sodium-benzoate by hypo, and oxygen inhalations. The urine was positive for barbiturates. Death occurred approximately 30 hours after taking the drug.

Case 2.—R. O., a young naval medical officer. Diagnosis: Psychoneurosis, reactive depression. For several days prior to this episode patient had appeared brighter and more cheerful. At 8 a. m., on the 18th of January he could not be aroused for breakfast. The officer of the day was notified and patient was promptly seen. Coramine, 5 cubic centimeters given intravenously, because the respiration was shallow and irregular. There was apparently no response to the intravenous coramine. Within 5 minutes a large urticarial wheel was noted on the right face and auricle. He was given 0.5 cubic centimeter of adrenalin intramuscularly. Gastric lavage done and 2 ounces of magnesium sulphate with 10 milligrams of benzedrine and 300 cubic centimeters of black coffee were left in stomach. We saw the patient at 8:30 a. m., respiration was shallow and stertorous and the tongue continued to fall back in throat; 3.75 grains of caffeine-sodium-benzoate were given subcutaneously. Three hundred cubic centimeters of urine, obtained by catheterization, contained 40 milligrams percent barbiturates. Given intravenous injection of 500 cubic centimeters dextrose in normal saline and hypodermoclysis of 1,000 cubic centimeters in thighs. Shortly after 11 a. m., the patient stopped breathing and artificial respiration by the Shaeffer method was carried on for 30 minutes before a shallow respiratory rate was resumed. At this time strychnine, grains 1/32, was given and followed in 30 minutes by picrotoxin, grains 1/100. The blood pressure reading was 92/56. Within 20 minutes after using picrotoxin blood pressure was 110/70. Patient began to breathe well and deeply, 95 percent oxygen and 5 percent carbon dioxide was administered. Blood pressure continued elevated. Catheterized specimen at 2 p. m., yielded only 200 cubic centimeters of urine, showing 20 milligrams percent of barbiturates. Strychnine grains 1/32 and picrotoxin grains 1/100 were given each hour alternately for two doses of each. Patient placed under oxygen tent about 3 p. m. The pupils began to react fairly well to light but general flaccidity and collapse continued. At 10 p. m., he was breathing well, color good, face flushed, respiration and cardiac function continued to improve. Blood pressure continued up during the night. At 4 a. m., January 19, patient tried to move hands and legs, yawned and attempted to move head. This was the first evidence of voluntary movement exhibited since his discovery almost 24 hours previously. At 7 a. m., 500 cubic centimeters of normal saline with 50 cubic centimeters of 50 percent glucose were given intravenously. Catheterized specimen urine at 8:30 a. m., of 500 cubic centimeters, showed 20 milligrams percent barbiturates. During the morning the patient became more restless, opened his eyes, and there was occasional mumbling response to loud questioning. He received 1,200 cubic centimeters of normal saline and glucose intravenously at 11:30 a. m. During late afternoon the oxygen tent was removed. The temperature was 100.6 by axilla; pulse, 96; respirations, 20. At 4:30 p. m., patient asked to speak to medical officer. He was confused but appeared to be recovering consciousness. During evening he was able to take liquid nourishment by mouth. Voided voluntarily for first time at 6:15 p. m. 250 cubic centimeters. This specimen contained 15 milligrams percent barbiturates. He was visited by his wife at 10:30 p. m., and although there was considerable clouding of consciousness, he recognized her and could respond in a fairly rational manner. During the third day, January 20, patient was confused, showed moderate clouding of consciousness and was disoriented as to time, thought he

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had only been asleep one night. Said he felt dizzy and light headed and ached in all of his joints. Specimen of urine through the third and fourth days continued to contain from 15 milligrams percent to a trace of barbiturates. On the fourth day the patient had made an excellent recovery with exception of persistent feeling of dizziness and the complaint that he could still taste barbital, especially when he smoked cigarettes. He admitted taking forty 3-grain capsules of sodium amytal at 8 p. m. January 17.

SUMMARY

We have attempted to review the symptomatology, pathology and diagnosis of acute poisoning with barbiturates. The problem of treatment and prognosis has not yet been standardized. The use of therapeutic agents is reviewed in some detail. The histories of two representative cases are presented. It is seen that prognosis depends upon the type and quantity of drug taken, the time that elapses before therapy is instituted, the condition of the patient, and the administration of antagonistic drugs in heavy dosage, as guided by the depth of respiratory depression and degree of vascular collapse.

CONCLUSION

It is our opinion that patients may recover from enormous doses of the barbiturates but that they will do so only after prompt, energetic, and persistent treatment has been carried out.

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CARBOXIDE POISONING

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Since the use of carboxide gas (ethylene oxide 1 part and carbon dioxide 10 parts) has been adopted by the Navy for fumigation purposes, it is of interest to note the effect on personnel who have been subjected to its fumes, of unknown concentration, for a period of 2 to 3 hours.

A search of the available literature failed to reveal any reference to any toxic effects due to carboxide. The toxicity of ethylene oxide has been determined experimentally on the guinea pig and Barber (1) cites the records of five fatal human cases of poisoning due to di-ethylene di-oxide in which the characteristic findings were a central necrosis of the liver without fatty degeneration or jaundice and terminating in about a week with a hemorrhagic nephritis and uremia.

As the articles published in the Naval Medical Bulletin also did not describe any toxic effect on human beings, the following report is made. On May 21, 1936, the ship's company of the U. S. S. *S-36* at the Navy Yard, Cavite, P. I., fumigated all spaces forward of the engine room (15,000 cubic feet), using six 60-pound cylinders of carboxide at 725 pounds pressure per square inch at 70° F. Fumigation was begun at 6:15 p. m. and was stopped at 9:15 p. m. The watertight door in the forward bulkhead of the engine room was dogged. There was a vent in the flapper valves from the torpedo room to the after-motor room in which six men had been working since 4 p. m.

At about 9:30 p. m., these men appeared at the yard dispensary complaining of headache, nausea, and vomiting. These symptoms continued for the next 2½ hours after which they were discharged to their homes. As no other cause for their condition could be found, it was decided that there was a leakage of the carboxide through the vent into the compartment where they were working. As the toxic substance was inhaled in the form of a gas, the resulting vomiting was considered as of central origin. It was therefore decided to examine the respiratory tract, the heart, the blood, and the urine of the patients for evidence of any resulting ill effects. The respiratory tract was examined physically and by X-ray, the heart by physical examination and blood pressure, the blood by blood chemistry and blood counts, and the urine by routine examinations. These examinations were conducted the following day and failed to show any ill effects resulting from the inhalation of the gas.

SUMMARY

1. After exposure for about 2½ to 3 hours to inhalation of a weak concentration of carboxide fumes, the toxic effects consisted of headache, nausea, weakness, and vomiting.

2. The symptoms lasted for about 2½ hours.
3. The treatment consisted of gastric lavage.
4. No permanent ill effects were noted in examination of the respiratory and circulatory systems, blood, or urine.
5. Precautions should be taken to confine the fumes to the parts of the ship being fumigated.
6. Men should not be allowed to work where there is any possibility of even a weak concentration of the fumes to reach them.

Our thanks are due to Lt. Comdr. W. H. Whitmore (M. C.), United States Navy, for the X-ray reports and to Lt. (Jr. Gr.) F. W. Farrar (M. C.), United States Navy, for the reports on the blood chemistry.

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THE SULFANILAMIDE THERAPY OF GONORRHEA

By R. H. Snowden, Commander, Medical Corps, United States Navy, and Robert A. Bell, Lieutenant, Medical Corps, United States Navy [1]

In recent decades rapid progress has been recorded in preventive and curative treatment of many diseases. There have been several groups including streptococci, genococci, and virus diseases remaining resistant to therapeutic efforts. The original work of Domagk (1) on the azo-dye derivative Prontosil has developed a promising line of attack (2) (3) on at least the first two of this hitherto resistant group. The therapeutic effect of the azo-dyes apparently resides in the reduction derivative para-amino-benzene-sulfonamide (4) (6f) (7) (13b) called sulfanilamide (5) from which they are formed. This reduction occurs both in vitro and in vivo. The use of this drug is not yet on a scientific basis. The mode of action is not understood. Solutions of sulfanilamide 1:13,000 and 1:18,000 in defibrinated human and monkey blood or serum were found free from implanted cultures of beta-hemolytic streptococci in 2 days (11) (13a). In controls there was an increase of organisms. Frequent repetition of the experiment using different strains of streptococci and different bloods gave similar results. With the blood of rats, mice, and guinea pigs results were less favorable. Sulfanilamide inhibits growth and causes death of pneumococci in 24 to 48 hours in solutions of 1:10,000 or stronger. It is effective in less marked degree in 1:100,000 dilutions (12). No effect was demonstrable on virulent hemolytic streptococci in 1:1,000 dilutions, or on staphlococcus albus or E. coli. However, larger doses of streptococci were used than by others (11) (14b) who obtained inhibition of organisms.

[1] We are indebted to W. L. Ainsworth, Commander, U. S. Navy, executive officer, U. S. S. *Mississippi* for the supply of sulfanilamide used in this study. The authors wish to express appreciation to Hugh D. Smith, pharmacist mate, third-class, for his thorough technical assistance.

In vivo experiments (11) (14) (confirmed (15) and (13b) including pneumococci types I and II and certain Neisseriae) show good therapeutic results with sulfanilamide in mice infected with hemolytic streptococci of high virulence. Little effect was observed with strains of low virulence. Favorable results have been obtained (16) with strains of medium virulence by using from 1–10 minimum lethal doses. Animals experimentally infected intraperitoneally with pneumococci exhibit prolonged life incident to sulfanilamide therapy. While they show peritonitis with a purulent exudate at autopsy (12) the infection is more markedly localized than in controls which present intense bacteriemia. No bacteriostatic effect was noted (13b) on staphlococcus aureus, E. coli,. E. typhi and certain other gram negative organisms. The sulfanilamide therapy of guinea pigs infected intradermally with hemolytic streptococci has shown (16) less dissemination, greater localization, and more rapid healing as compared to untreated controls.

The drug possesses marked bacteriostatic and bactericidal action in vitro. If this is the mode of action in vivo it is unproven. Diazotization and acetylation of sulfanilamide destroys its activity in vitro and in vivo indicating a similar mode of action (12). The results of in vitro experiments cannot however be applied directly to those in vivo. This is apparent (12) for sulfanilamide in the test tube is more than 100 times as bacteriostatic and bactericidal against pneumococci as compared with streptococci whereas in mice it is more effective against streptococci. This action in vitro is adequate to explain the chemotherapeutic effect against pneumococci in animals if dosage of 1 gram per kilo is given. The concentration thus obtained in the body is comparable to that in the test tube. However it has been shown (1) that against streptococci in mice, from one-tenth to one-fiftieth of the tolerated dose gives a distinct effect if treatment is continued for 3 to 5 days. To explain the variance of action between test-tube and animal experiments enhanced bactericidal action of the blood, supplemented by that of the tissues of the whole animal, has been supposed (11). However, Meyer (19), injecting streptococci intraperitoneally in guinea pigs, concluded that prontosil does not prevent the growth of bacteria, for in treated pigs, killed after a time, billions of organisms were found. The treatment promoted phagocytosis and seemed to diminish virulence and inhibit toxin formation. It is believed (13b) the stimulation of granulocytic and monocytic phagocytosis is favored by injury to the organisms rendering them more susceptible; or that capsular production by streptococci may be interfered with (17) and a neutralizing effect upon the leucocidins and hemolysins of streptococci in vitro is shown. However, in an excellent study (16) of the effects of sulfanilamide upon hemolytic streptococcus infections ("Stoddard" and

"Pion" strains) in mice and guinea pigs no qualitative differences in histologic response were noted in treated and untreated animals. There was little or no evidence of increased phagocytic activity by either granulocytic or reticulo-endothelial cells. The presence of masses of organisms in both treated and untreated animals does not favor the suggestion that the bactericidal activity of the blood, supplemented by that of the tissues as a whole, can account for the favorable effect of sulfanilamide. There was no evidence that phagocytosis was a factor in obtaining favorable therapeutic results.

Possibly some of these variable results can be explained by experimental results recently reported by Finklestone-Sayliss and associates. (18) These investigators report that the bacteriostatic action of sulfanilamide on streptococci seeded into fibrinated serum varies markedly depending upon the age of the culture. Using an 8-hour strain the action during the first 4 hours is that of a marked growth stimulation. During the next 4 hours the growth curve presents an even more precipitous fall. Older cultures are proportionately less responsive. These investigators noted that sulfanilamide is far more soluble in the fatty envelope of the streptococci than it is in aqueous solution, and that, the fatty envelope decreases with age. They are of the opinion that the chemical acts first as a stimulant and later as a depressant. This stimulatory action was also demonstrated in animal experimentation. They could demonstrate neither stimulation nor depression of phagocitic activity, and confirmed Colebrook's findings that the bactericidal action of sulfanilamide does not require the presence of leucocytes. Sulfanilamide was found to have a definite stimulatory action on the granulocyte production in that crises would occur when the total white cell count might reach 30,000. They report that the chemical's action on the bone marrow has little effect on hemopoietic function although showers of abnormal nucleated red cells may occur during the crises. There was apparently no stimulation of the reticulo-endothelial system, although the phagocytic activity of these cells was definitely increased. Animals that died under treatment had petechial hemorrhages in the gastric mucosa, muscles, and connective tissue.

Certain conclusions are apparent:

1. Sulfanilamide is bacteriostatic and bactericidal in vitro.
2. Results relative to destruction of organisms in the peritoneal cavity are contradictory.
3. A diffuse peritonitis does follow the intraperitoneal injection of organisms in spite of therapy.
4. Sulfanilamide therapy none the less does preserve life despite the multiplication of organisms.
5. It results in less dissemination, greater localization, and more rapid healing of the infection.

6. The evidence suggests its action in vivo is antitoxic, possibly also antibacterial.
7. That phagocytosis is an important factor is questionable.

A colorimetric method has been devised (24) for determining the concentration of sulfanilamide in the body fluids. The human excretes the drug in unchanged and conjugated form. The latter is mainly para-acetylamino-benzene sulphonamide. Their relative importance in effecting a clinical cure remains conjectural. The conjugated derivative is nearly inactive (24). Acetylation and diazotization of sulfanilamide destroys its activity (12). The urine of patients excreting sulfanilamide has no bactericidal activity against beta-hemolytic streptococci (20) but it has been found capable of destroying the bacteria usually causative of urinary infections (21).

Experimental results (6), (13b), (16) indicate that the maximal curative result is exerted by maintaining a high concentration of this substance in blood and tissues for several days. A blood level of sulfanilamide of 10 milligram percent is therapeutically satisfactory (6f). The optimum dosage for this attainment varies. It lies near 15 or 20 grains four times daily. This is much less than the 1 gram per kilo dosage commonly used in animal experiments. It compares favorably with the results obtained in streptococcus infections in mice (1) using one-tenth to one-fiftieth of the tolerated dose. Differences in absorption rate exist in humans (24). Absorption is nearly complete in 4 hours. For this reason divided doses are preferable. Equilibrium between intake and output is established in 2 to 3 days and then nearly 100 percent of the intake may be recovered from the urine.

The toxic effects of this drug are frequent but usually not alarming. They soon subside after withdrawal. Large amounts of fluid act as an antidote. Apparently few fatalities have occurred (36). The toxicity is low. The minimal lethal mouse dose following single subcutaneous injections in olive oil is 6 grams per kilo of body weight. Two grains or more per kilo produces spasticity of the extremities, excitability, and incoordination. They tolerate 1 grain per kilo indefinitely. Similar symptoms have been noted in humans (26) including toxic optic neuritis (27), mental dullness, confusion, lassitude, giddiness, and sleepiness are common. These toxic effects are usually mild, appear early during drug ingestion, and either disappear or are well tolerated after 48 hours even if treatment is continued.

Cyanosis occurs in up to 75 percent (6f) of cases. It is best observed by slaty nail beds and bluing of the lips of varying intensity. It may be associated with methemoglobinemia, an aniline effect, not unexpected, since sulfonanilamide is an aniline derivative. It also contains a sulfamido group. Sulfhemoglobinemia occurs (6f), (15), (21), (22), and the administration of sulfates is thought to be predisposing. The sulfhemoglobin is slowly removed from the blood

having been observed 6 weeks after drug ingestion ceased (21). Methemoglobin disappears in 24 hours. Spectroscopic examination of the blood is a more delicate means of detecting sulfhemoglobinemia than is clinical observation of cyanosis (21), (24).

A fall in the blood CO_2 combining power is frequent (6f) having been found in 15 consecutive cases (23).

A febrile reaction was noted in 15.6 percent of cases (33), and must be differentiated from a bacterial effect. It may develop during the first day or two of drug ingestion but occurs more frequently following prolonged therapy. Various subjective symptoms of toxicity accompany the fever and other objective findings are commonly present. A dermatitis was noted in 9 of 21 cases (33). Cutaneous eruptions are frequent (28), (29), (30), (32), (34), (35) and vary from a maculo-papular erythema to purpuric areas (29), (33) with intense pruritis often present. These eruptions usually occur on exposed areas and are attributed to exposure to sunlight (30), (34), (35) due to a photo-sensitizing property of the drug. Both dermatitis and febrile reaction may appear after reduction in dosage or even after the drug is discontinued. They may disappear even though treatment is continued and rapidly subside after drug withdrawal. The administration of small doses of the drug has been noted to induce toxic recurrences (29), (30), (31), (32) and positive patch tests are reported. However, this evidence of cellular sensitizing properties is not universally found for negative intradermal and patch tests, absence of precipitins in the blood serum and passive senistization tests in humans and guinea pigs have yielded negative results (33).

A depression of hepatic function is revealed by the bromsulphalein test (37) and jaundice may develop (13a) (33). This subsides upon drug withdrawal. In one case (13a) the subsequent administration of large doses of sulfanilamide failed to provoke a recurrence.

Renal irritation does not occur (6f) but the drug is excreted slowly by damaged kidneys. In such patients cessation of therapy is indicated when blood levels reach 15-20 milligram percent.

The drug may exert a profound effect upon the hematopoetic system. Since it contains a benzene ring this is not unexpected. Apparently certain persons are more susceptible, i. e., have a sulfanilamide idiosyncrasy. Granulocytic maturation may be inhibited and one death has been attributed (36) to agranulocytosis. However, many case reports indicate that granulocytic stimulation also occurs and leukocyte counts up to 83,000 have been reported. The relative importance of the underlying infection must be assessed but some cases show an increase of immature granulocytic cells after institution of therapy. A moderate eosinophilia is not uncommon. The red blood cells are also attacked, producing acute hemolytic anemia, 5 cases (38), 5 cases (37), and 1 case (31). Skin testing and repetition of therapy after

recovery has failed (37) to provoke a recurrence. The anemia is associated with the appearance of nucleated red blood cells, polychromatophilia, anisocytosis, and poikilocytosis. The serum bilirubin is increased and urobilinuria occurs.

The drug sulfanilamide has been accepted for New and Nonofficial Remedies (3) as a therapeutic agent for the treatment of infections by hemolytic streptococci of Lancefield's serologic group A. This includes most of the hemolytic streptococci causative of acute severe infections in man. It has been used successfully in mouse protection experiments with meningococcus infections (6a, b, d, e) and in similar infections in humans (6c, f). Another compound (disulfanilamide) possesses a better therapeutic index in streptococcus and meningococcus infections if given subcutaneously (6d).

The effectiveness of sulfanilamide in meningococcus infections suggested its use in those due to the gonococcus which is closely related biologically. A series of 47 cases of various types of gonococcic infection of the genito-urinary tract has been reported (9). In 36 cases the gonococci and the urethral discharge disappeared in less than 5 days. In five cases the subjective symptoms disappeared completely; there was a marked diminution in the urethral discharge, but the gonococci were still present. Three cases showed no response to the drug. Three other cases showed prompt response, but treatment was discontinued and the infection recurred. In two of these cases it disappeared following a second course of treatment. In no instance was there a progression of the infection. The possibility of late recurrences was recognized. The prompt subsidence of burning and frequency was noted. Alcohol and sexual excitement were prohibited. Another report (10) of 100 sulfanilamide treated cases (40 grains daily) included 40 new infection cases with 3 treatment failures and 60 old infection cases with 7 treatment failures. The average length of time for clinical recovery was 5 days. The criterion for cure was the disappearance of microscopic pus from the urine, absence of pus from the prostate gland, loss of all symptoms and the failure of recurrence. In a third report of 31 cases of gonorrhea (25) 4 were classed as failures. Two failures were males with symptoms after a week of therapy. Two were women with positive cultures at the conclusion of treatment. One case of arthritis responded nicely. In these cases once clinical cure was established a daily dose of 20 grains was continued for 10 to 14 days.

The clinical observations reported present unusual optimism. There is need for reporting of clinical controls. A survey of sulfanilamide treated cases is presented. The diagnosis of gonococcic infection was made on the demonstration of gram negative intracellular diplococci of typical morphology and distribution in the stained smear of yellowish urethral discharge which appeared in from

3 to 10 days following sexual exposure. All cases were restricted to the ship thus restricting alcohol and sexual exposure. No local, oral or dietary measures were instituted. These patients continued ambulant and performed their routine duties. The only treatment given during the period covered by this report was sulfanilamide orally. The dosage varied slightly in certain cases but approximated 4 grams daily for 2 days, then 2 grams daily for 6 days and 3 grams daily for 6 more days. Each case was observed daily. At least every other day the amount of urethral discharge was noted and gram stained and the two-glass urine test recorded. Each case was charted but due to lack of space only one representative chart is presented for each group.

CASE REPORTS

The 15 cases studied are subdivided as follows:

Recent infection cases reacting favorably, 5

Case 1.—J. F. M., seaman second class. Exposed July 1, 1937; initial symptoms July 3, 1937. Presented with profuse purulent urethral discharge. Meatus acutely inflamed. Two-glass test, cloudy—clear.

July 6, 1937: Sulfanilamide started.

July 14, 1937: White blood cells 6,650, bands 5, segs. 60, lymphs. 32, monos. 2, eosins. 1.

July 16, 1937: Two-glass test, clear—clear. Discharge—none. Smear of urethral scraping positive.

July 20, 1937: Smear of urethral scraping positive.

July 23, 1937: Smear of urethral scraping positive.

July 25, 1937: Sulfanilamide discontinued.

July 30, 1937: Smear of urethral scraping negative. Prostate normal to palpation. Secretion contains 1–2 leukocytes per high-dry field. No organisms.

August 5, 1937: Prostate normal. Smear negative.

Case 2.—J. Y. M., seaman first class. Exposed July 12, 1937. Presented July 17, 1937 with a slight urethral discharge. Meatus not inflamed. Two-glass test, cloudy—clear. Sulfanilamide started.

July 21, 1937: Smear positive.

July 22, 1937: Smear negative and continued so through August 5, 1937.

August 1, 1937: No discharge. Two-glass test, clear—clear.

August 4, 1937: Prostate normal. Expressed secretion shows many leukocytes, no organisms. Sulfanilamide discontinued.

Case 3.—A. D. H., ship's cook third class. Exposed June 22, 1937. Presented June 29, 1937 with slight purulent urethral discharge. Meatus not inflamed. Two-glass test, shred—clear. Sulfanilamide started.

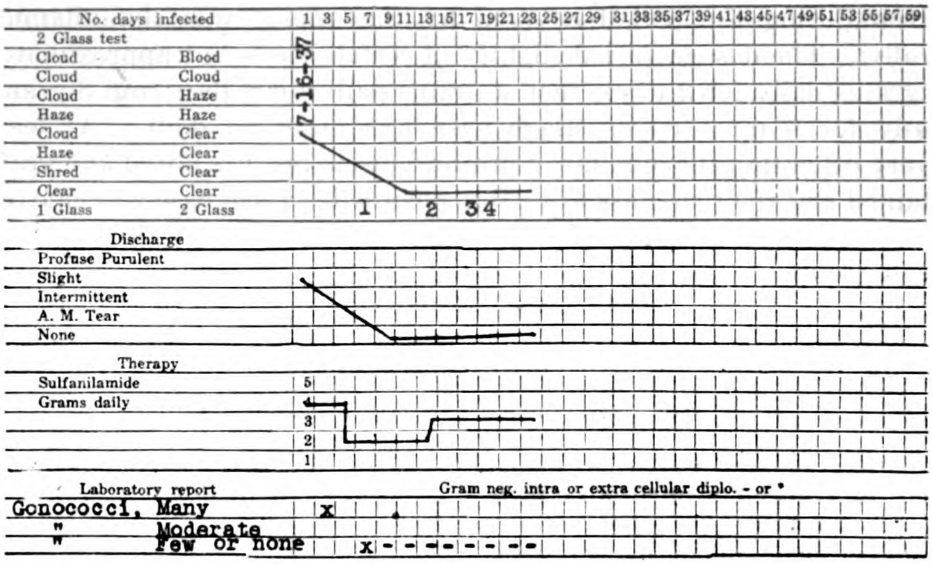
July 12, 1937: No discharge; two-glass test, clear—clear. Smear negative. Sulfanilamide discontinued.

July 21, 1937: Smears continue negative. Prostate slightly enlarged, not indurated. Expressed secretion contains 1–2 leukocytes per high-dry field. No organisms. Toxic symptoms—slight dullness.

Case 4.—U. S. S. *Mississippi*, H. R. B., seaman first class, Division C. Exposed July 12, 1937. Initial sympton July 14, 1937. Reported for treatment July 16, 1937. Present symptoms: Slight yellowish urethral discharge. Burning upon

urination. Meatus not acutely inflamed. Laboratory report shows many intra and extracellular gram negative diplococci. Many pus cells.

CHART I



1. July 22, 1937: W. B. C. 6,350. Hgb. 85 percent. Differential: Bands 8, seg. 66, lymph. 24, mono. 2.

2. July 28, 1937: W. B. C. 7,800. Hgb. 85 percent. R. B. C. 4,580,000. Differential: Bands 5, seg. 64, lymph. 27, mono. 3, baso. 1.

3. August 1, 1937: Prostate normal. Expressed secretion normal.

4. August 3, 1937: Prostate normal. Expressed secretion normal.

Case 5.—J. C. F., seaman second class. Exposed July 25, 1937. Presented July 28, 1937 with scanty urethral discharge. Two-glass test, haze—clear. Sulfanilamide started.

July 31, 1937: No discharge. Two-glass test, clear—clear. Smear of urethral scrapings negative.

August 6, 1937: Sulfanilamide discontinued.

August 12, 1937: Prostate enlarged, not indurated. Expressed secretion contains many leukocytes, no organisms. Smears of urethral scrap ngs have remained negative.

Recent infection cases reacting unfavorably, 6

Case 6.—J. K. K., ship's cook second class. Exposed June 12, 1937. Presented June 23, 1937 with a profuse purulent urethral discharge, meatus acutely inflamed. Two-glass test, cloudy—clear. Sulfanilamide started.

July 1, 1937: White blood cells 7,100, bands 8, seg. 62, lymphs. 26, monos. 4.

July 21, 1937: White blood cells 7,500, bands 10, segs. 60, lymphs. 23, monos. 4, eosins. 1, baso. 2. Two-glass test, haze—haze. Discharge—morning tear. Smear positive.

July 27, 1937: Differential white blood cells: Bands 2, segs. 68, lymphs.18, monos. 3, eosins. 9. Two-glass test, haze—haze. Discharge consists of morning tear. Sulfanilamide continued.

August 5, 1937: Morning tear positive for gram negative intracellular diplococci. Prostate slightly indurated and nodular. Secretion contains many leukocytes, no organisms.

Case 7.—E. E. C., seaman first class. Exposed June 8, 1937. Presented June 11, 1937 with a profuse purulent urethral discharge, itching and burning on urination, meatus acutely inflamed. Two-glass test, cloudy—cloudy. Sulfanilamide started.

June 30, 1937: Epididymitis, acute right—in bed 4 days.

July 22, 1937: White blood cells 7,450, bands 8, segs. 65, lymphs. 25, monos. 2.

August 9, 1937: Prostate slightly enlarged, irregular, not tender. Expressed secretion contains many leukocytes and gonococci. Two-glass test, haze—haze. Discharge slight and positive for gonococci. Sulfanilamide discontinued.

Case 8.—T. N. J., seaman first class. Exposed July 4, 1937. Presented July 7, 1937, with a purulent urethral discharge and acutely inflamed meatus. Two-glass test, shred—clear. Sulfanilamide started.

July 11, 1937: Two-glass test, cloud—haze.

July 15, 1937: Two-glass test, shred—clear. Discharge had decreased to morning tear.

July 19, 1937: Discharge profuse and purulent.

July 27, 1937: White blood cells 7,000, bands 2, segs. 43, lymphs. 50, monos. 2, eosins. 2, basos. 1.

July 31, 1937: Discharge profuse, positive for gonococci. Prostatic infection present.

August 6, 1937: No change. Sulfanilamide discontinued.

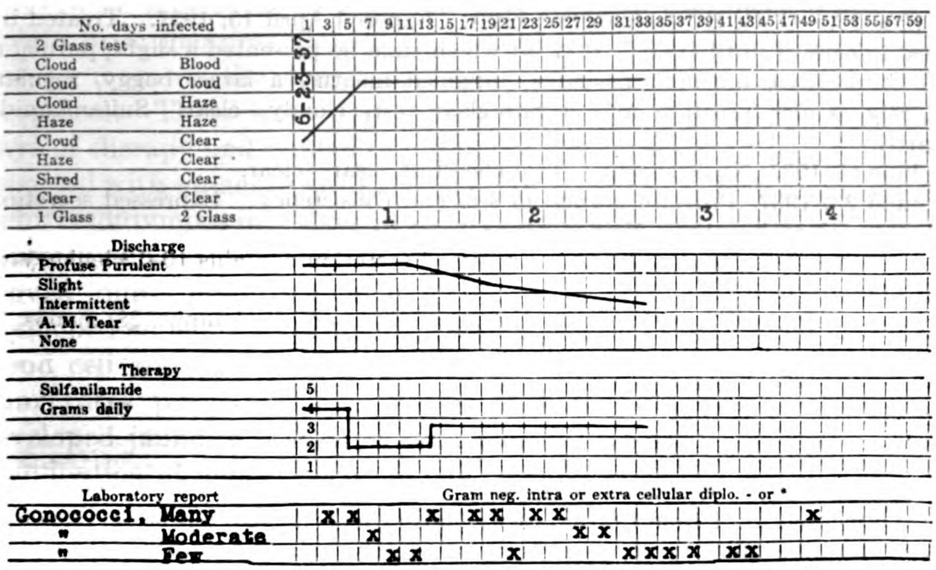
Case 9.—H. G. M., seaman first class. Exposed June 27, 1937. Presented July 4, 1937, with a scanty yellowish urethral discharge. Two-glass test, cloudy—clear. Sulfanilamide started.

July 21, 1937: White blood cells 4,700, bands 10, segs. 70, lymphs. 16, monos. 4.

July 29, 1937: Urethral discharge intermittent and positive for gonococci. Two-glass test, haze—clear. Sulfanilamide discontinued.

Case 10.—U. S. S. *Mississippi*, H. E. L., fireman first class, division B. Exposed June 20, 1937. Initial symptom June 22, 1937. Reported for treatment June 23, 1937. Present symptoms: Profuse purulent urethral discharge. Meatus inflamed. Laboratory report shows many leukocytes, many gram negative intra- and extra-cellular diplococci. See chart II.

CHART II



1. July 1, 1937: White blood cells 8,100. Differential: Bands 8, segs. 68, lymphs. 18, monos. 5, eosin. 1.

2. July 15, 1937: White blood cells 6,500. Differential: Bands 5, segs. 47, lymphs. 35, monos. 6, eosins. 5, basos. 2.

3. July 31, 1937: Prostate increased in size, nodular and indurated. Expressed secretion shows many leukocytes and scattered groups of gram negative diplococci.

4. August 12, 1937: Prostate is indurated and nodular. Expressed secretion shows a few gonococci.

Case 11.—S. N. L., seaman first class. Exposed June 22, 1937. Presented June 29, 1937, with a profuse urethral discharge and an acutely inflamed meatus. Two-glass test, cloudy—clear. Sulfanilamide started.

July 15, 1937: Discharge profuse. Two-glass test, cloudy—cloudy. White blood cells 7,300, bands 8, segs. 50, lymphs. 26, monos. 5, eosins. 10, baso. 1.

July 23, 1937: Complication—acute inflammation of distal tendinous insertion right rectus femoris.

July 29, 1937: Discharge slight but positive for gonococci. Two-glass test, cloudy—cloudy. Sulfanilamide discontinued.

Old infection cases reacting favorably, 2

Case 12.—T. M. G., private. Exposed April 2, 1937. Treated by local injections until June 6, 1937, at which time he presented a purulent urethral discharge with an acutely inflamed meatus. Positive for gonococci. Two-glass test, shred—clear. There was a subacute prostatitis and he was recovering from a right epididymitis. Sulfanilamide started.

June 11, 1937: No discharge. Two-glass test, clear—clear. Smear of urethral scraping positive for gonococci.

June 17, 1937: Has continued to show no discharge. Two-glass test, clear—clear. Urethral scraping negative for gonococci, for past 5 days. Prostate is normal in size, shape, and consistency. Expressed secretion contains clumps of gram negative diplococci.

June 25, 1937: Three prostatic examinations negative. Sulfanilamide discontinued.

June 29, 1937: White blood cells 9,300, bands 8, segs. 43, lymphs. 43, monos. 4, eosins. 2.

Case 13.—C. G. H., seaman first class. Exposed April 15, 1937. Treated by local injections until June 7, 1937, at which time he presented a slight, purulent, G. C. positive, urethral discharge, inflamed meatus, a large, boggy, regular, slightly tender prostate and a two-glass test, cloudy—clear. Sulfanilamide started.

June 15, 1937: No discharge. Two-glass test, clear—clear.

June 23, 1937: Prostate normal in size and consistency. Expressed secretion loaded with leukocytes. No organisms.

June 27, 1937: Prostate same. Expressed secretion contains 10–12 leukocytes per high dry field.

June 29, 1937: White blood cells 6,000, bands 5, segs. 55, lymphs. 28, monos 7, eosin. 1, basos. 4. Sulfanilamide discontinued.

July 1, 1937: Prostate normal.

Old infection cases reacting unfavorably, 2

Case 14.—T. N. R., seamen first class. Exposed May 28, 1937. Treated with local injections until June 19, 1937 at which time he presented a profuse, purulent, G. C. positive urethral discharge and an acutely inflamed meatus. Two-glass test, cloudy—cloudy. Sulfanilamide started.

June 29, 1937: No discharge, urethral scrapings G. C. positive. White blood cells 8,100, bands 6, segs. 45, lymphs. 38, monos. 5, eosins. 3, basos. 3.

July 21, 1937: Discharge—purulent morning tear, G. C. positive. Two-glass test, haze—clear. White blood cells 9,300, bands 8, segs. 42, lymphs. 44, monos. 3, eosins. 3. Sulfanilamide discontinued.

Case 15.— E. L. R., seamen second class. Exposed May 1, 1937. Turned in May 31, 1937 because of an acute vasitis, right. Presented a scanty, yellowish, purulent, G. C. positive urethral discharge. Two-glass test, cloudy—cloudy. Prostatitis, acute. Seminal vesiculitis, acute. Sulfanilamide started.

June 7, 1937: Epididymitis, right, acute—9 sick days. Discharge consists of morning tear, G. C. positive.

June 22, 1937: Discharge same. Prostatitis still present.

July 1, 1937: Prostate normal in size and consistency, not tender. Expressed secretion contains many leukocytes, no organisms. Vesicles not palpable. Right epididymis presents slight residual induration of globus major and minor.

July 30, 1937: Discharge of morning tear, G. C. positive Prostate normal. Expressed secretion normal. White blood cells 6,100, bands 8, segs. 42, lymphs. 40, monos. 6, eosin. 1, basos. 3. Sulfanilamide discontinued.

SUMMARY

Of the 15 cases studied 4 were old cases in that their infection had been treated locally prior to the use of sulfanilamide. Eleven of the cases were recent infections. Of the old infection cases 2 reacted favorably, 2 unfavorably. Of the new infection cases 5 reacted favorably, 6 unfavorably. A patient's reaction was considered favorable if all symptoms and signs (including negative gram stain of the urethral scrapings) disappeared and there was no recurrence. The favorably reacting recent cases were definitely mild infections. They did not present profuse urethral discharge or the acutely inflamed, pouting urethral orifice so commonly noted. The two chronic cases which reacted favorably had been under treatment for some time. They were improving at the time this therapy was instituted. No severe toxic manifestations were noted. All patients complained of one or more of the symptoms: Lassitude, giddiness, confusion, or sleepiness. These were particularly noticeable during the first few days of therapy and tended to become less troublesome. One patient reported with an acute vasitis, right, and went on to develop an acute right epididymitis in 7 days in spite of sulfanilamide treatment. His course was unsatisfactory throughout. The epididymitis, however, proved quite mild and pain was not preeminent. Another case developed an acute teno-myositis which cleared up in 4 days. White blood cell and differential counts were done on 12 of the 15 cases. Four cases presented eosinophilia of 3 to 10 percent. No case developed jaundice, dermatitis, neuritis, or hemolytic anemia. The examination of many smears of the urethral discharge did not reveal any increase of phagocytosis of gonococci.

CONCLUSIONS

In cases of gonorrhea sulfanilamide therapy causes:

1. Prompt disappearance of urethral discharge in some cases.
2. Gonococci persist in urethral scrapings for several days after the subsidence of the urethral discharge.
3. Prompt subsidence of symptoms of burning and frequency in all cases.
4. Metastatic extension of the infection does occur.
5. Disabling complications which have occurred have run a short course, subsided quickly, and were attended by less fever, less pain, and less discomfort than usual.
6. No evidence of increased phagocytosis of gonoccoci was observed.
7. The rapid subsidence of discharge, symptoms, and urethral inflammation in favorably reacting cases suggests control of gonotoxin (19).
8. If a case does not react favorably within 2 weeks it is not likely to do so.

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SULFANILAMIDE TREATMENT OF LUDWIG'S ANGINA

By JAMES E. FULGHUM, Lieutenant, Medical Corps, United States Naval Reserve

Ludwig's Angina is a diffuse cellulitis of submaxillary region and floor of the mouth which may eventuate in gangrene of the skin or mucous membrane. The swelling usually progresses rapidly, spreading toward the neck and upwards into the floor of the mouth. The swelling is board-like resembling that seen in carcinoma of the neck. The floor of the mouth and tongue are elevated with the latter pushed toward the affected side. Sepsis is marked. In unchecked cases, the mortality rate is high. The condition is usually secondary to extraction of teeth or infections of throat or tonsils and the invading organism is usually the streptococcus. The treatment heretofore has been early and adequate incision with drainage and hot fomentations. Streptococcus serum has been used.

CASE REPORT

This is a case report of a white female child, age 3 years, who had always been healthy with no history of any illness before the onset of present infection.

Present illness.—Parents give a history of a fall 1 week prior to infection in which a small area of skin was abraded from the anterior surface of the chin. This was given first-aid care by the mother who applied mercurochrome. On August 22, 1937, during the late morning, the parents noted that the child was drowsy, ill, and fretful, had anorexia and some temperature. She refused food during the day of the 22d. She was put to bed on the same evening. During that night, she was extremely restless, cried out, and complained of pain in the submaxillary region. The mother noticed a firm swelling in this region but thought that it was glandular. By early morning, the swelling had increased alarmingly fast and was then the size of an egg. The temperature rose steadily and by early morning was quite high. She could not eat or drink anything after 5 a. m. on the morning of the 23d.

Physical examination.—I saw her at my office at 6 a. m., August 23, 1937. The swelling of the submaxillary region was about the size of a lemon and felt like carcinoma of the neck. It was quite tender and not movable. The tongue was pushed up into the roof of the mouth and the mouth could not be opened except

enough to insert a tongue depressor between the teeth. The temperature was 102.5° and the child was acutely ill. There was a scab on the chin which was lifted off and a small amount of pus was obtained for a microscopic study. Smear showed short-chain streptococci. Gentian violet was painted on the abraded area. Blood: White blood cells, 16,300; red blood cells, 4,496,000; polys, 85 percent; lymphs, 15 percent; haemoglobin, 80 percent. Urine: Reaction, acid; sp. gr., 1.020; albumin, negative; glucose, negative; micro, negative; color, red.

Treatment.—I decided to use sulfanilamide as treatment since other diseases of streptococcic etiology have yielded to this preparation. Accordingly, 5 cubic centimeters of 25 percent sulfanilamide was given intramuscularly each 4 hours for 4 doses. The swelling did not increase any in size during the day of the 23d. The only sign of improvement was the fact that the child asked for water about 4:30 p. m. and drank freely. On August 24th, the child was seen again at 6 a. m. She was much brighter, temperature was 99.6°, and she was able to take liquid diet and fluids freely. By 12 noon, she was able to eat solid food in small quantities. The swelling was decreasing in size slowly and the board-like hardness was not quite as evident. Blood: White blood cells, 18,050; polys, 94 percent; lymphs, 6 percent. During that day, three doses, 3.5 cubic centimeters each, of 2.5 percent sulfanilamide were given.

The morning of the 25th, the child had improved rapidly, was playful, temperature was normal, and the swelling was still regressing. She was able to eat and food was asked for. Blood: White blood cells, 16,500; polys, 68 percent; lymphs, 26 percent; endothelial, 1 percent; eosinophils, 5 percent.

On the 26th, the child was given 2 injections of 2 cubic centimeters each of 2.5 percent sulfanilamide. She was feeling well except for a mild acute bronchitis. She had a temperature of 99.5° which I thought probably due to the bronchitis. Blood: White blood cells, 11,000; polys, 64 percent; lymphs, 34 percent; eosinophils, 2 percent.

On the 27th, she was given one injection, 2 cubic centimeters of 2.5 percent sulfanilamide. The child appeared normal except for a small swelling of about the size of a small marble in the submaxillary region. This was not hard, neither did it fluxate. It seemed to be resolving without pus formation. Blood: White blood cells, 10,600; polys,60 percent; lymphs, 38 percent; eosinophils, 2 percent.

Patient was seen again on the morning of the 28th. Temperature was still normal and the child appeared to be well. Further rapid regression had occurred in the swelling, and still no pus formation. Sulfanilamide was given in 1.5 cubic centimeters dose and the patient discharged to return again in 3 days for further examination. Blood: White blood cells, 9,200; polys, 61 percent; lymphs, 38 percent; eosin, 1 percent.

SUMMARY

Ludwig's Angina in a 3-year-old child due to streptococci entering from lesion on chin, treated with sulfanilamide intramuscularly, with an arrest of the progress of the disease, and gradual regression of swelling without pus formation and rapid return to normal as compared to the usual surgical treatment. Although I am reporting only one case, I feel that we have a valuable medical treatment for Ludwig's Angina due to streptococci, and that by its use, the mortality rate of this dreaded condition will be greatly decreased.

PSYCHOSIS PRECIPITATED BY SULFANILAMIDE

By Bartholomew W. Hogan, Lieutenant, Medical Corps, United States Navy, and Philip J. McNamara, Lieutenant, junior grade, Medical Corps, United States Navy

This is a preliminary report of one of the cases of a series now being studied under the direction of the urological service, United States Naval Hospital, Washington, D. C. The object of the series is to aid in the determination of the role of sulfanilamide in the treatment of gonococcus infections. Complete results of this series will appear at a later date.

CASE REPORT [1]

A. C., private, United States Marine Corps; age, 21; was admitted to this hospital August 27, 1937, from the marine detachment on duty at this hospital.

Chief complaint.—Urethral discharge, frequency, burning and stinging on urination, and rather constant severe pain in the perineum of 1 week's duration.

Family history and past history.—Noncontributory as regards this illness.

Present illness.—May be considered to date back to December 1935, at which time he had his first diagnosis of gonococcal infection of urethra. A concurrent prostatitis complicated his condition, but he was finally considered apparently well after extensive treatment ending June 1936. He entered the United States Naval Hospital, Washington, D. C., October 17, 1936, with diagnosis of gonococcus infection of prostate. He received treatment and was returned to duty December 28, 1936, with instructions to continue treatment as an ambulatory patient. About July 1, 1937, he was again considered apparently well but advised to have a periodic check-up on his prostate. On August 27, 1937, he was admitted again to this hospital with the chief complaint mentioned above. Further information showed that he had occasional recent sexual exposures.

Physical examination on admission was essentially negative except for a profuse purulent urethral discharge and a moderately enlarged, tender and indurated prostate. A smear of the urethral discharge was positive for gram negative intracellular diplococci. Blood studies were all normal. Kahn and Wasserman reaction were negative. Urinalysis was negative except for 3 to 6 white blood cells per high-power field.

His diagnosis was considered to be gonococcus infection of prostate.

Clinical course.—In the hospital consisted of bed rest and general supportive measures until August 30, 1937, 3 days after admission, at which time it was decided to start him on a course of sulfanilamide. He received 80 grains of sulfanilamide daily for 2 days; 60 grains daily for 9 days; and 40 grains daily for 6 days. On September 16, 1937, sulfanilamide was stopped because of disappearance of complaints. Total dosage, 940 grains. On September 21, 1937, his prostatic secretion was found to contain gram negative intracellular diplococci and a morning tear had returned. He was again started on sulfanilamide September 21, 1937, 80 grains daily for 2 days; 60 grains daily for 2 days. On September 24, 1937, he presented himself to the ward medical officer requesting something be done about "conditions in general", and in particular "the attitude" of his fellow patients and the hospital corpsmen. He was of the opinion that a conspiracy was on foot to bring about his discharge from the Marine Corps and he threatened to jump ship if action on his behalf was not immediately obtained. He wondered if he was "slipping mentally and wanted to check up on this before things went too far." Further administration of sulfanilamide was discontinued

[1] Submitted for publication Oct. 25, 1937.

this date and patient was transferred to the neuropsychiatric service for observation and treatment. Total dosage sulfanilamide, second course, 280 grains.

Up to this time his reactions had been normal and his conduct in the ward had been satisfactory. Complete blood studies, including quantitative blood sulfanilamide determinations had been done biweekly. Temperature, pulse, and respiration were charted daily. He remained under constant medical supervision and was restricted to the urological ward. He seemed to be tolerating the drug very well as far as could be determined by physical signs and laboratory data. The highest blood sulfanilamide concentration was 7.7 milligrams per 100 cubic centimeters. The lowest red blood count was 4,240,000 per cubic millimeter, with a hemoglobin of 81 percent. The lowest CO_2 combining power was 52 volumes percent. Quantitative urine sulfanilamide determination showed good elimination.

Résumé of psychiatric findings.—Patient's past history shows him to have been somewhat unstable, a behavior problem, making a poor adjustment in his home and school life. He gave no history of previous nervous or mental illness. His father is a practicing physician. No family history of mental illness. While on active duty with the marine detachment at this station and for 3 weeks following admission to the sick list he exhibited normal behavior.

His psychotic picture was characterized first by mild paranoid feelings with apprehension and restlessness. He became acutely psychotic, entertaining auditory and visual hallucinations with a fairly clear sensorium. He stated that he saw his relatives around the hospital and that his mother was talking from the floor above. The picture continued to resemble a toxic delirium, dreamlike fancies and bewilderment. Because of his desire to escape to locate his mother, he was transferred to St. Elizabeths Hospital, where he has made and maintained a gradual improvement at this writing (Oct. 25, 1937).

SUMMARY

1. A case of gonococcus infection of prostate was treated over a period of 3 weeks with sulfanilamide.
2. An acute onset of a psychotic condition was apparently precipitated by the administration of sulfanilamide.
3. The psychotic picture resembled that usually seen in toxic psychoses.
4. One month later, following the withdrawal of the drug, there is a definite improvement in the mental state.

SULFANILAMIDE POISONING

Report of Fatal Case

By J. T. O'Connell, Lieutenant Commander, Medical Corps, United States Navy

R. S. C., seaman, first class, was admitted to the United States naval hospital, San Diego, Calif., September 25, 1937.

Chief complaint.—Sore throat and fever.

Family history.—Father died of influenza at 35. Mother died of influenza at 30. No brothers or sisters. Denies familial diseases.

Past history.—Born in Texas. Had the usual childhood diseases. Enlisted October 1934, and has had continuous service since. Operations: appendectomy, 1936. Illness, gonorrhea, 1935–37. Denies syphilis.

Present illness.—Last night patient had a severe chill followed by fever, and he reported to the sick bay. This morning his throat became sore and he was transferred to this hospital. Temperature on arrival, 104.4; pulse, 126; respiration, 28. Patient's health record shows that he had been under treatment for chronic gonorrhea treated with sulfanilamide as follows:

September 1, 1937, 70 grains.
September 2, 1937, 70 grains.
September 3, 1937, 55 grains.
September 4, 1937, 55 grains.
September 5, 1937, 55 grains.
September 6, 1937, 30 grains.
September 7, 1937, 30 grains.

During this course of treatment blood counts were made and no change was noted. On the sixth day of treatment he had white blood cells, 5,650; 75 percent polys; red blood cells and hemoglobin normal. Treatment was discontinued after the seventh day because he developed acute catarrhal fever. In a couple of days he was feeling well and the urethral discharge had stopped. When he reported to the sick bay on his ship last night he had a mild sore throat and was given routine "cold" treatment. His temperature was 102.0. This morning his temperature was 104.4; pulse, 130; respiration, 34. White blood cells, 3,500; polys, 0 percent; lymphs, 99 percent; monocytes, 1 percent; red blood cells, 3,910,000; hemoglobin, 80 percent. He was transferred with a diagnosis of agranulocytosis.

Physical examination.—Well-developed and well-nourished young white male of 22 lying in bed and appearing acutely ill, but rational and clear mentally.

Head:
- Eyes: Pupils equal, regular, and react normally. Conjunctivae icteric.
- Nose and ears: Negative.
- Mouth: Tongue negative. Teeth in good repair and hygiene. Throat reddened and inflamed. No ulcerations. Tonsils inflamed but not markedly.

Neck: Anterior cervical glands palpable.
Chest:
- Lungs: Negative to percussion and auscultation.
- Heart: Normal position. Rate and rhythm regular and very rapid. No murmurs.
- Blood pressure, 110/60.

Abdomen: Rounded and soft. Appendectomy scar, right rectus incision.
Genitals: Negative. No urethral discharge.
Extremities: Reflexes normal. Rhomberg negative.

Treatment and clinical course.—September 25, he received 1,000 cubic centimeters of saline solution intravenously. At 9:30 p. m. he received 10 cubic centimeters of pentnucleotide.

September 26. He was made a strictly bed patient with forced fluids and liquid diet and pneumonia jacket. White blood count, 650; lymphs, 100 percent; urine, 20 milligrams albumin. He received 10 cubic centimeters of pentnucleotide at 9:30 a. m., 2 p. m., 6 p. m., and 10 p. m.; deep X-ray therapy, long bones; and morphine p. r. n. At 4 p. m. his temperature was 105.0; pulse, 140; respiration, 32.

September 27. Twenty-four-hour fluid intake, 2,905 cubic centimeters, output 1,690 cubic centimeters. Red blood cells, 3,110,000; hemoglobin, 90 percent. Patient had considerable edema of the throat for which an ice collar was used.

He received 5 cubic centimeters of leucocytic extract intramuscularly at 11 a. m., 4:30 p. m., and 10:30 p. m. He was given 325 cubic centimeters of blood by indirect method at noon, and 1,000 cubic centimeters of normal saline by hypodermoclysis at 4:30 p. m., and a similar amount with 5 percent glucose intravenously at 10:30 p. m.

September 28. Swelling of the neck increased; patient became semicomatose and was placed on the critical list. Oxygen tent was applied at 5:20 a. m. Temperature, 102.0; pulse, 142 and weak; respiration, 33. Red blood cells, 3,240,000; white blood cells, 500; lymphs, 100 percent. At 1:40 p. m. his blood pressure was 84/58 and white blood cells, 650; lymphs, 100 percent. Urine, specific gravity, 1.015; albumin, 30 milligrams; positive for red blood cells and occult blood with a few granular casts. Kahn, negative.

Patient received morphine one-fourth grain at 0040 a. m. and 9:45 p. m.; leucocytic extract, 5 cubic centimeters at 10:30 a. m. and 10 cubic centimeters at 6:10 p. m. intramuscularly; blood transfusion, 200 cubic centimeters of citrated blood at 11:45 a. m.; normal saline 1,000 cubic centimeters by hypodermoclysis at 5:00 p. m. and 1,000 cubic centimeters normal saline with 5 percent glucose intravenously at 10:00 p. m.

At 10:50 p. m. patient became cyanotic, and an airway device was inserted for relief. He failed to respond to coramine at 11:15 p. m. and died at 11:34 p. m. September 28, 1937.

Autopsy findings.—1. Agranulocytosis. 2. Edema of the glottis.

SUMMARY

This patient was hospitalized because of a sore throat and fever of overnight duration. The blood picture showed a total absence of granulocytes, confirming the diagnosis under which he was admitted. There was a history of taking 365 grains of sulfanilamide over a period of 7 days 3 weeks ago. The patient was critically ill with ulceration and swelling of the throat. The hemopoietic system failed to respond to X-ray therapy to long bones, "Pentnucleotide" leucocytic extract, or two blood transfusions. The leucopenia with agranulocytosis persisted and the patient died after 3 days' illness. A 100-tablet bottle of Prontylin (Winthrop) containing 22 5-grain tablets was found in the patient's effects. This finding would suggest that he may have taken an unknown amount of sulfanilamide in addition to that prescribed.

RESULTS OF SULFANILAMIDE THERAPY OF GONORRHEA

By E. R. Hering, Lieutenant, Medical Corps, United States Navy

The use of sulfanilamide in the treatment of gonococcus infections was instituted at the United States Marine Corps Base, San Diego, Calif., on June 9, 1937. The observations noted in this paper cover the period from that time until August 28, 1937. The data reported in this paper covers the observations on 46 cases of gonorrheal infec-

tion and a group of 15 cases of post-gonorrheal involvement where no positive smears could be obtained, streptococci infection of the throat, and cellulitis of various parts of the body. These 15 cases are included to show the percentage of reactions occurring in a total of 61 individuals treated with sulfanilamide.

NEW CASES

This group comprised 29 cases which were seen within the first 2 days of beginning of symptoms, and which had had no other type of treatment. Table I shows the results obtained in these 29 cases. Classification A, table I, includes those cases which were symptom free within 5 days and which, after observation of from 1 week to 2 months, have remained so. Two-glass tests and smears on these cases have all been negative, and they have been considered as cures. Classification B, table I, includes those cases which were cleared up within 30 days. Most of these cases showed negative smears after 15 days, and the infection ran a very mild course. In some of these cases silvol, 5 percent, was given by urethral injection and served to dry up the mucous discharge after smears were negative. Classification C, table I, includes those cases which still showed positive smears after 30 days' treatment with sulfanilamide and were considered as failures, although the sulfanilamide was considered of possible value in preventing complications.

TABLE I

	Cases	Percent
Classification A	12	42
Classification B	7	24
Classification C	10	34

CHRONIC CASES

This group comprised 17 cases which had had more or less continuous urethral discharge for a period of from 2 months to 2 years. All of these cases had positive smears when treatment with sulfanilamide was started. Table II shows results obtained in this group. Classification A, table II, includes those cases in which discharge was completely stopped and smears were negative after 6 to 8 days' treatment. It is not presumed that all these cases in classification A were completely cured. However, most of these cases were ones that reported to the sick bay as soon as they learned that sulfanilamide was being used (2½ months ago), and have since that time shown no clinical evidence of gonorrheal infection. Classification B, table II, includes those cases that showed no clinical response to sulfanilamide within 30 days. This group is especially interesting because of the complete and rapid amelioration of symptoms after various other

forms of treatment over a period of from 2 months to 2 years had failed.

TABLE II

	Cases	Percent
Classification A	15	88
Cassification B	2	12
Total	17	

MISCELLANEOUS CASES

This is a group of 15 cases including streptococcic infection of the throat, cellulitis of various parts of the body, and nonspecific urethritis and prostatitis. They were not of a sufficient number to form a basis for any definite conclusions, but are included in order to compile the percentage of reactions in the total of 61 cases which were given sulfanilamide.

DOSAGE

When the drug was first used, it was customary to give 30 to 45 grains daily for the first 2 days and then raise the dosage to 60 grains daily for the next 3 days, depending on how the case was progressing. As we became more familiar with the drug, we started with 80 grains daily for the first 2 days followed by 60 grains daily for the next 3 days, and then gradually decreasing the dose until 10 days' treatment had been given. No better results appeared to have been achieved by this method, and we now give the drug in the following manner:

	Grains daily
3 days	60
3 days	45
3 days	30
3 days	15
Total, 12 days	450

The tablets are given three times daily, after meals.

REACTIONS

Reactions from sulfanilamide were divided roughly into three main types, viz., skin, constitutional, and renal reactions. Some of the cases showed a combination of the skin and constitutional types, but they are listed under the classification of their most predominant symptoms.

Skin reactions.—These reactions varied from a slight papular rash on the hands, arms, face, and neck to a severe involvement of the same areas with marked edema and weeping eczematoid lesions. These reactions occurred from the second to the eighth day of treatment and lasted from 2 to 5 days, depending on their severity, following discontinuance of the drug. Figure 1 illustrates a severe form of this skin reaction.

In all there were 12 skin reactions in the group of 61 cases. However, there were only three which could be classified as severe, the other nine being of very little consequence. It is interesting to note that the manifestations appeared on the surfaces of the body exposed to the weather, and the three severe cases had been exposed to the direct rays of the sun during the whole day previous to the occurrence of the eruption.

Constitutional reactions.—This group consisted of four cases which gave symptoms of general malaise, headache, nausea, and some vertigo. They were very mild, showing no rise in temperature, or pulse. Practically half of the cases in the entire series, on questioning, stated that they experienced some drowsiness, but these four were the only ones that had sufficient subjective symptoms to complain of voluntarily. The symptoms disappeared within 24 hours after discontinuance of the drug.

Renal complications.—This group consisted of four cases which developed what is believed to have been, for want of a better term, an irritative or chemical pyelitis. They showed a rise in temperature to 100°–103° F., and the urine showed a heavy concentration of pus cells. No casts or erythrocytes were found in the urine. All four of these cases developed their symptoms after the gonorrheal symptoms had disappeared, within 6 to 8 days after starting the treatment. Constitutional symptoms disappeared and the urine promptly became free of pus cells within 2 days after discontinuance of the drug.

Classification of these four cases under the heading of renal complications may be misleading, but the fact that these four were the only ones of the entire series that showed a concentration of pus cells in the urine along with constitutional symptoms seems to point to some irritation of the kidney in this group.

All of the 61 cases were given a complete blood count at least once during the course of treatment. At no time was there found any decrease in the blood elements. In fact, in most of the cases which had reactions, the leukocyte count showed a rise of from 3 to 5 thousand with very little shift to the left.

TREATMENT OF REACITONS

The only treatment of reactions consisted of rest in bed, forcing fluids to aid in elimination of the drug, and large doses of sodium bicarbonate. During the latter part of this series, sodium bicarbonate, from 60 to 90 grains, was given daily in conjunction with the treatment as a prophylactic measure, but it is impossible to state at this time whether or not it was of much value.

CONCLUSIONS

1. Sulfanilamide appears to have a specific effect on gonorrheal infection in a great majority of the cases.

FIGURE I.—SKIN REACTION. SULFANILAMIDE.

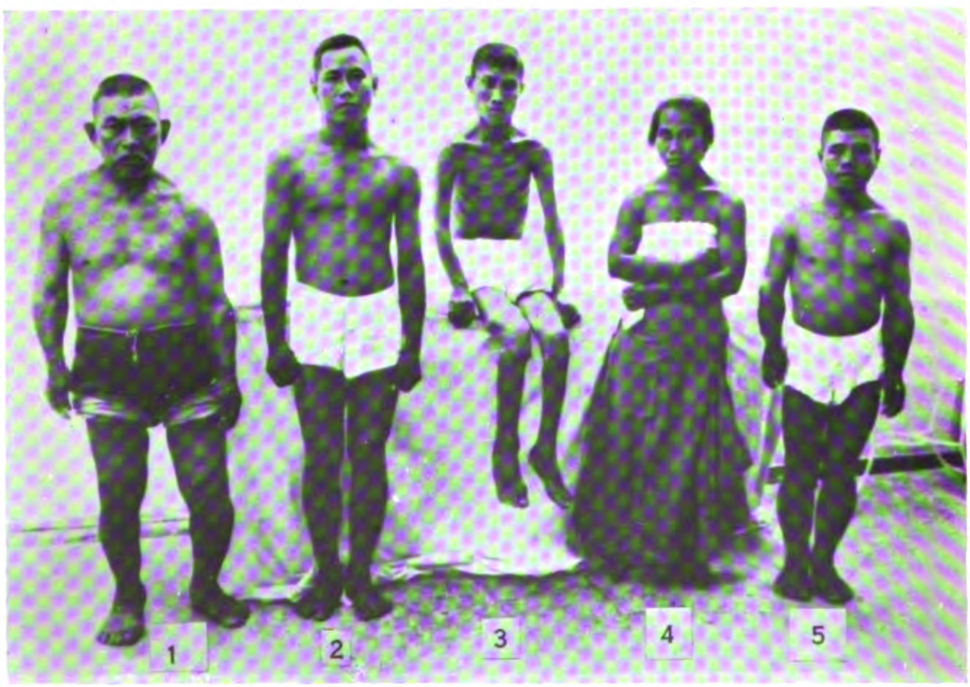

FIGURE II.—CHONDRODYSTROPHY FETALIS.

2. It is most efficacious when used at the earliest possible moment, and its most striking effects take place within the first 5 days.

3. Sulfanilamide is especially efficacious in producing clinical cures in long-standing cases of gonorrhea.

4. Sulfanilamide appears to eliminate complications and lessen the severity of the infection, even in those cases which do not respond immediately to the drug.

5. Sulfanilamide is capable of causing severe reactions, and should only be given under the strict supervision of a medical officer.

6. Direct exposure to intense sunlight appears to have some effect in increasing the severity of skin reactions.

CHONDRODYSTROPHY FETALIS

By WILLARD S. SARGENT, Lieutenant Commander, Medical Corps, United States Navy.

This condition is also called achondroplasia or microlelia. It is more of a cartilage dystrophy than achondroplasia, therefore chondrodystrophy is probably a better term.

It is a congenital affection in which the stature is small and at birth the legs and arms are proportionately smaller than the trunk; the latter may be of nearly normal size.

ETIOLOGY

The real cause is entirely problematic and unknown. Some say heredity plays a part in this disease and some say it does not. Both sexes are affected and it has been said that males transmit the disease. It has been attributed to placental changes or to intrauterine infection with consequent epiphyseal changes or destruction, which changes probably occur in the first half of intrauterine existence. Some, as might be supposed, blame the internal secretions and others have suggested a toxic basis.

It has been present in as many as three successive generations of males. A person with the condition may have normal or abnormal children.

PATHOLOGY

It is essentially a dystrophy of the epiphyseal cartilages of the long bones—a disturbance of normal ossification. The cartilage atrophies and ossification occurs early, causing the bones to become distorted, the joints limited and growth retarded, and since it begins in utero, the earlier it starts the more marked the deformity. The cartilaginous skeleton essentially suffers and it rarely involves the membranous bones.

The bones of the arms and legs are the ones mostly affected, but the tribasilar bone in the floor of the skull may be involved and ossify

early, causing disproportion of the vault. The long bones become bowed and shortened and as the periosteum continues its usual function of bone formation the bones enlarge in diameter and the connective tissue from the periosteum invades the epiphysis, which unites prematurely with the diaphysis, stopping growth. The growth makes the arms and legs stumpy, while the head and trunk are apt to be normal. The epiphyses are frequently enlarged. The ossa innominata and ribs also frequently suffer. The glands of internal secretion are rarely involved, and a few cases may have precocious sexual development, but this is not an essential of the disease and other evidences of pituitary affection are not present. The genitalia are apt to be normal.

It is a malformation of bone and the enchondral matrix may be defective in its development.

The nasal bone depression is due to lack of development in which it differs from lues which is due to diseased bone.

SYMPTOMS

The fetus may be aborted, it may be still-born, it may die while an infant, or may live a few years and then die. If it lives beyond childhood it is likely to grow to adult life and die at any age from other causes; being usually robust and well muscled, but dwarfed. As a child it walks late and, while it is usually somewhat disabled, the muscles are apt to be well-developed later even though in some cases movements are painful. The number reaching adult life are few; they have average intelligence; the head is of normal size or larger. As the person grows from childhood to adult life the condition gradually becomes more marked as the limbs and deficient cartilage areas do not keep pace with the parts of the body unaffected. The vault of the cranium is prominent at the parietal and frontal areas and the nose being depressed makes the forehead seem still more prominent. The trunk appears long but is actually shortened, the back is flat, lordosis is present and the scapulae short. The buttocks are enlarged and prominent. The belly is usually prominent due to the marked exaggeration of the lumbar curve. The hand has fingers of short length and the so-called trident hand is caused by a separation of the second and third fingers at the second phalangeal joint. The arms are short, the humerus is especially affected, the radius is longer than the ulna, which is usually deformed and shortened, and the hands are thick. The legs are short, and the femur is proportionately shorter than the bones of the leg. The fibula is longer than the tibia, and the limbs may be considerably bent or bowed. The bones are very thick at points of muscular attachment. The relative shortening of the ulna and tibia tends to produce bowing of the arms and legs. The joints are prominent, hyperostoses may form about the epiphyseal line, and joint disability may occur.

French describes the body as of the dachshund type. The normal curves are exaggerated which may make caesarean section necessary in pregnant women. The vertebrae often are effected, producing spinal deformity. The ribs may show deformity suggestive of the "rosary."

The fontanelles often close late in childhood and there may be a mild internal hydrocephalus.

The eyelids and lips are apt to be thick.

DIAGNOSIS

The history, the age of appearance of symptoms, the size, the X-ray, and the facies help to rule out acromegaly, leontiasis ossium, gout, arthritis, fragilitis ossium, osteomalacia, osteitis deformans, multiple exostosis, and osteogenesis imperfecta. Oxycephaly has an enlarged head, impaired vision and exophthalmos. Progressive facial hemiatrophy is not congenital, it shows discoloration of the skin, wrinkled and furrowed cheeks, the skin glands are functionless, and the teeth and eyebrows may fall out.

This leaves cretinism, rickets, syphilis, and yaws to be differentiated. Rickets is usually, though not always postnatal. The bones are soft, fracture easily, and the suture lines are insecure. There is no pug nose, and the spleen is apt to be enlarged. The limbs are not necessarily shorter than normal, and the stature may be little affected. Some have thought that achondroplasia is fetal rickets, but it is essentially different; at birth it simulates a case of severe grade of rickets which has run its course. In true achondroplasia the bones remain distorted, the joints are limited in range of motion, general body growth is retarded, and only the milder cases may reach adult life. The X-ray shows greater enlargement of the epiphyses in rickets. In chondrodystrophy the enlargement of the epiphyses may be slight or absent and the lesions are in the cartilage, but exostosis may form at this region or at muscular attachments on the bone. The lesions are complete at birth and the later deformity is the result of the early lesions. The X-ray further shows the curved and short bones in the chondrodystrophy. The latter has the disproportion between the trunk and extremities and the more striking deformities. Most cases of rickets appear after the sixth month; excess cartilage is produced, the periosteum fails to lay down bone, bone is absorbed from the canal, and ossification is irregular.

The muscles in rickets show lack of tone, the lymph glands may be enlarged, the liver is often enlarged, and the patient is subject to complications. Deformities are more frequent in the lower than the upper extremity because of weight bearing. The humerus is rarely deformed, the wrists are broad, the knees and ankles are large, and

bowlegs or knock-knees are apt to develop. Necrosis never occurs in rickets.

Cretinism has the so-called myxedematous cachexia and defective growth of the bony skeleton. The patients are mentally slow, have a peculiar blank facies, enlarged tongue, small stature, old-looking appearance, and are benefited by thyroid therapy. The hair is scanty and coarse, while in achondroplasia it is abundant and soft. The thyroid is apt to be absent, atrophied, or goitrous. The skull bones are thick, the sutures remain open, and the fontanelles close late. Symptoms are not usually noted till 1 year of age or more. The skin is dry, coarse, thick, and does not pit on pressure. The extremities are apt to be short and stubby but lack the characteristic deformity of chrondrodystrophy. The affection is general and not selective.

Syphilis and yaws are the same disease or else very similar. It is lesions of the nasal bones in these that give the depression and not lack of development as in chondrodystrophy. Necrosis occurs in lues but not in chondrodystrophy. In congenital lues the long bones, especially the tibia, are most frequently affected, particularly near the epiphysis, which causes a broadening. Proliferating changes occur in the periosteum, with periostitis. The tibiae often have nodules or show roughening. Gumma are rare, although pain at night often occurs in lues of bones and the Kahn test is usually positive.

Yaws as seen in the tropics with such extensive bone involvement would probably involve the nose, throat, and face and produce gangosa.

PROGNOSIS

The condition is present at birth and becomes accentuated as age progresses. Abortion may occur before the fetus is developed or it may be still-born. It may die soon after or in the first few years of life. The prognosis as to life is not good till after the first year or so of existence but after this the prognosis as to life is good, but as to altering or curing the condition it is hopeless.

TREATMENT

No treatment is of any avail.

CASE REPORTS

Case 1.—M. J. M. Male. Age 69. Height, 57 inches; weight, 164 pounds. No history of yaws. Kahn negative. Father and one uncle, who are now dead, had the same affliction and he is very sure he was born with this condition. He is the father of cases 2, 3, 4, and 5. See illustration, figure 2. His skull measures 23 inches around. His arms and legs, including the bones, are short, curved, and deformed and he has a tilt to the body. The bones by measurement show the right ulna to be 6 inches and the right radius 7 inches long, while the left ulna is 7 and the left radius 8 inches long. This together with a shorter humerus on the right side gives a right arm 2 inches shorter than the left. An osteophyte appears

at the insertion of the right deltoid. The distal end of both ulnæ taper and give narrow wrists.

Case 2.—M. J. M. Age 27. Height, 65 inches; weight, 135 pounds. The right side of his face is smaller than his left. His skull is 20 inches in circumference. The right half is 9½ and the left 10½ inches. There is no discoloration of the skin, no wrinkled or furrowed cheek, no falling out of the teeth or eyebrows, and no lack of function of the skin glands as there is in facial hemiatrophy. I was unsuccessful in trying to get a picture of the tribasilar bone of the skull.

Case 3.—M. A. M. Age 23. Male. As seen by the picture he is a marked case of tuberculosis. Since I got the picture he had died. I did an autopsy; the lung infection was marked but nothing else abnormal was found except these numerous or multiple exostoses. He is not a dwarf but he shows these exostoses in the neighborhood of epiphyses, so I put him in the picture since he shows cartilage dystrophy. It goes without saying that he is not a case of chrondrodystrophy fetalis but being a cartilage abnormality, I thought it might give a small point of suggestion of heredity here. He had these exostoses all his life.

Case 4.—M. M. M. Female. Age 22. Height, 5 feet; weight, 115 pounds. The circumference of the skull is 21 inches, the face is normal, and the mentality is normal. The right humerus is shorter than her left humerus. Her family are very sure she was born this way since her father took notice at birth of all children, because of his own affection. The right humerus is 10 inches and the left is 11¾ inches long. As shown by the picture her left wrist is narrow. There are exostoses in the center of the right humerus at the insertion of the coracobrachialis and deltoid. The chest cage is normal. The second and third right toes are shorter and of equal length. The lower end of each ulna is tapered. There is no sign of yaws or gangosa and her Kahn is negative.

Case 5.—M. J. M. Age 25. Single. Male. There is no history or evidence of yaws or gangosa, and his Kahn is negative. The right side of his body is smaller than his left but it is not an hemiatrophy or hemihypertrophy because both sides of his body are affected. His condition was present at birth but has become more evident as he grew older. His mentality is normal and there is no internal glandular affection. His head measures 21½ inches around, the right half being 10 and the left half 11½ inches. The right side of his face is smaller; the X-ray of his skull also shows this. All his teeth are present including the wisdom teeth. The hair on the head is soft and abundant. The bridge of the nose is sunken in. His eyelids and lips are thick.

The right arm is 22 and the left 26 inches long, the right humerus being 10 and the left 10½ inches. The two prominences on the outer side of the right forearm are bone ends; the upper is the radius projecting beyond the joint, and the lower is the short distal end of the ulna. The right radius is 7½ and the right ulna is 5 inches long, while the left radius is 7¼ and the left ulna is 6¾ inches long. The left radius is prominent distally yet both wrists are narrow and the metacarpals are short. The right index finger is shorter than the others and both hands show the trident effect. Lordosis is present, the genitals are normal, the inguinal crease and the gluteal fold are lower on the right side, and the trunk is 25 inches from the first dorsal spine to the end of the coccyx.

The left leg is 1 inch longer than the right and the right kneecap is lower than the left while the right tibia projects at the upper and inner end. The left femur is 13½ inches while the right is 1 inch shorter. The left tibia is 13 and the fibula 11½ inches but the right is ½ inch shorter in each bone. The first metatarsals are only 2 inches long and the toes are all short; the second and third right toes are of the same length and relatively shorter. The bones throughout are distorted somewhat and show thickening at muscular attachments with hyperostoses in many places.

Case 6.—Female. Age 22. Height 57 inches; weight 90 pounds. The circumference of her head is 20½ inches. Her family were all normal, but her father's father had a similar condition. There is no history of yaws but her Kahn is 4 plus; this case is the only one in the entire group I am reporting that has a positive Kahn test. Her mentality is normal or above average. Her legs and arms are short and her trunk is proportionately longer than the limbs. The legs are not grossly deformed but the bones are shorter than normal, and a few exostoses are present. The ribs are normal and the pelvis is contracted and small. The buttocks are large and prominent, some lordosis is present and the abdomen is large on side view.

Her right arm is longer than her left by 1½ inches. The fingers are short, especially the right thumb, index finger, and little finger. The arms and forearms are short and the wrists are narrow, especially the right. The right humerus is 10 and the left humerus 9½ inches long. The right ulna is 5 and the right radius is 6½ inches long. The left ulna is 5 and the left radius is 6 inches long. In both forearms the ulna is larger above and very small and pointed below. The radius in each case is bent and the head of each bone projects beyond the joint and is forward.

Case 7.—J. R. S. Female. Single. Age 34. Sister to cases 8 and 9. She is 54 inches tall and weighs 108 pounds and has normal mentality. Her father is dead; he had a similar affection. There is no history of yaws in the family or herself, and her Kahn is negative. Both legs and arms are short and the body relatively long with a small pelvis. The left humerus and forearm are much shorter than the right. The wrists are narrow and the fingers are short. The right hand shows the trident effect. There is a small projection on left elbow which is the head of the radius covered only by skin. The right humerus is 10¾ and the left 10¼ inches long. The right radius is 8 and the ulna 8½ inches long; the radius is bowed, and lower ulna tapers and is deformed slightly. The left ulna tapers, is small distally, has no styloid process, is deeply placed at the wrist region, hardly extends to the wrist, and is 6 inches long. The left radius is curved, large distally, projects beyond the joint, and is seen projecting at the elbow. The circumference of the head is 21½ inches. All the toes are short, the left second and third markedly so.

Case 8.—J. R. S. Male. Age 36. Married. This case is 57½ inches tall and weighs 102 pounds. Brother to case 7. The Kahn is negative. He has good intelligence. The skull measures 22½ inches. He has short arms and legs and his body is proportionately longer. The hands, especially the left, show the trident effect. The wrists are narrow and the fingers are short. The metacarpals are short. There are osteophytes on several bones. Both bones in both forearms are deformed and short, and the ulnar bones are small distally so that the ulnar prominence is lacking. The right ulna is 6 and the right radius 7 inches long. The left ulna is 6 and the left radius 7½ inches long. The humeri are short and are each 10½ inches long. The right second and third toes are shorter than the others.

Case 9.—J. R. S. Male. Single. Age 30. Brother to cases 7 and 8. This case is 61 inches tall, or a few inches taller than the others. The skull measures 22½ inches. Kahn, negative. No past history of yaws. He has tuberculosis. He has the trident right hand. This case has short metacarpals, the peculiar distal ulnar deformity, exostosis around some epiphyses, but he is not typically short. His humeri are about 11 inches. His ulna and radius of each arm are about 8½ inches long. His left second and third toes are shorter than normal, compared to the others.

Case 10.—G. J. G. Male. Single. Age 26. Height 56 inches; weight 112 pounds. Kahn, negative. There is no family history of yaws, gangosa, or this

affection. He has no past history of yaws. His skull measures 23 inches in circumference. His arms and legs are short; his body is actually short, but relatively long. His left arm is shorter than right. His chest cage is normal, but his lungs show tuberculosis. The femur and humeri are short and also his lower legs and forearms. The fingers and toes are short, but the trident hand is not definite. The third and fourth toes of the left foot are shorter than the others. There are exostoses about the epiphyses of several of the bones; a large one springing from the right upper epiphysis of the humerus presses against the chest wall and deforms the upper ribs. The metatarsals and metacarpals are short. The right humerus is 10½ inches long and the left is 10. The right radius is 6½ and the ulna 6 inches long. The left radius is 6 and the ulna 5 inches long.

SUMMARY AND COMMENT ON THESE CASES

As only few cases reach adult life, we would not expect to find the worst cases in adults and we might say that only the milder cases reach even puberty. Some of the cases may only have partial affections. I have not been able to find any children with this dystrophy and at autopsy on children no cases have been noted. The children of those in the group, except those of case 1, are normal. There are marked variations in the type and appearance of different cases. To illustrate this point I would refer the reader to pictures in the books of French, Graham, Bradford and Lovett, Spear and Coplin. The condition is said to be transmitted by males, which has been verified in these cases. Cases 1 to 5 are one family, Cases 7, 8, and 9 are a family in which the father (now dead) was affected. The grandfather of case 6 was affected. No relation with case 10 could be established. We must not overlook the fact that illegitimacy might fill in an otherwise unexplainable gap. Case 5 is the most typical of all. Cases 2 and 4 show changes less marked. Case 3 was put in to lend weight to an hereditary tendency. The faces of cases 2 and 5 are not hemiatrophy for reasons already explained. Case 6, the only one with a positive Kahn, has characteristics of the affection. Cases 7, 8, and 10 are types of it. Case 9 has only a few of the characteristics.

A superstitition held by some of the natives is that some time back some son struck his father and his punishment was handed down.

There being no signs of internal glandular affection, no thyroid was thought necessary as a therapeutic test. The mentality, in all cases, was normal, and other signs of cretinism were absent, and all these cases were congenitally affected.

In lues, necrosis occurs, the X-ray looks different, and a positive Kahn with some other evidence ought to be present. No case or relative has had a history of disease or treatment. Yaws is apt to involve the nose in late neglected cases.

In rickets a broad wrist is usual and the humerus is rarely deformed. In this condition a narrow wrist is present and the humerus is de-

formed frequently; and the hair is abundant and soft in all cases reported, while in rickets it is apt to be scanty and coarse.

A point noted in the literature is the frequency of bone thickening at muscular attachments and the exostoses at epiphyses, both of which were noted frequently in these cases.

In these cases we note the frequency of a long radius with the head projecting beyond the joint at the elbow, and a deformed short ulna with the ulnar distal prominence missing and a narrow wrist thereby being produced. The head in circumference is large for the rest of the body in all the group.

THE CANCER PROBLEM IN THE UNITED STATES NAVY

By Otis B. Spalding, Lieutenant Commander, Medical Corps, United States Navy

The cancer problem in the Navy must be viewed from three different aspects, as regards the active personnel; the military, the social, and the economic.

From a military standpoint the Navy is the fleet, and the great problem of the naval medical officer is largely one of preventive medicine. With thousands of officers and enlisted men afloat in the Battle Fleet, which for the past 5 years has based in the San Pedro-San Diego area, and with additional thousands afloat and ashore in our widely scattered naval stations and ships in the far distant ports of Samoa, Guam, the Philippines, China, and Hawaii, and our important shore stations along the Pacific coast, the management and control of malignancy naturally depend on the early recognition and prompt transfer of all such cases to the nearest naval hospital for treatment and final disposition.

Prior to July 1, 1936, it was the custom to send all inoperable cases that could be safely moved, to the United States Naval Hospital, Brooklyn, N. Y., for further treatment at the Memorial Hospital, New York. But here the social and economic feature affecting these unfortunate patients complicates the problem. Transfer of these cases from stations and hospitals on the Pacific coast, either by transport or train to New York, meant in many cases the breaking up of families, with the inevitable lowering of the patient's morale, which we all know to be of such vital importance in the treatment of such cases. The financial aspect was a serious problem to the families that follow patients to the east coast, and there is also the transportation cost to the Government of the patient and his attendants.

Taking these varied factors into consideration, the Bureau of Medicine and Surgery issued orders designating the Naval Hospital, Brooklyn, N. Y., as the cancer center of the east coast, including the Great Lakes-Chicago area; and the Naval Hospital, San Diego,

as the cancer center for the west coast and insular possessions. In compliance with this order the commanding officer of the Naval Hospital, San Diego, appointed a permanent cancer board on July 1, 1936, this board to consist of the following members: Chief of Medicine, president of the board; members, Chief of Surgery, Dermatology, Bacteriology and Pathology, Dental Surgery, and Radiology.

Since its inception the board has met at regular intervals in the auditorium of the Red Cross Building. All medical officers and visiting and local physicians have been welcomed and encouraged to enter into discussion of the cases.

All suspicious skin lesions and new growths admitted to the hospital or referred by medical or dental officers, afloat or ashore, are reviewed by the board at these meetings, and a decision made in each case as to probable diagnosis, and necessary treatment. All cases requiring surgery, or combined surgery and radiation, are treated by the staff. Biopsy is made in all operative cases, immediate frozen sections in all doubtful cases.

Since the cancer board at the San Diego Naval Hospital was officially organized, July 1, 1936, a total of 463 cases have been treated, requiring 2,322 treatments. Of these 463 cases, 356 cases were benign lesions or infections; 107 cases were malignant, proven by operation or biopsy. Of these 107 malignancies, 20 percent of all cases were basal cell epitheliomas, 8 percent epidermoid carcinomas, 15 percent adenocarcinomas, and 10 percent sarcomas.

There are 32 titles in the Navy nomenclature in the class of tumors covering malignant and benign neoplasms. Most of the admissions included in this class are recorded under such titles as simple retention cyst or wens, or other cystic growths.

A review of the annual reports of the Surgeon General of the United States Navy for the 5-year period 1931 to 1935, inclusive, reveals that there were 1,960 original admissions for all types of tumor. Of these 1,566 were benign conditions and 394 were malignant or of malignant tendency. In the benign group there were 2 deaths, 1 with benign mixed tumor and 1 with lymphangioma, and 15 were invalided from the service. Of the 394 malignant cases there were 65 deaths and 43 were invalided from the service.

The more common malignant tumors were represented as follows:

Tumor	Admissions	Deaths
Carcinoma	70	36
Epithelioma	46	0
Sarcoma	18	10
Tumor, malignant, mixed	18	5
Hodgkin's	13	4
Glioma	8	5

The admission rate per 100,000 for all tumors was as follows:

	Admissions	Deaths
1931	268	8
1932	294	12
1933	462	20
1934	419	18
1935	406	9

From the above survey it will be seen that the admission rate for the active list of the Navy per 100,000 is certainly no higher than the average rate for the same age group in civil life.

The selection by the Bureau of Medicine and Surgery of the San Diego Naval Hospital as the cancer center of the west was the logical result of not only its favorable location with regard to the fleet, but also due to the fact that it is a large and well-equipped hospital with a bed capacity of 1,070 and with an ultimate capacity when the new wing now under construction is completed of 1,270 beds. The X-ray department has recently been completely modernized with the installation of an oil-immersed shock proof deep therapy unit, activated by a special moisture-proof transformer of 300,000-volt capacity, 8 hours continuous operation at 20 m. a. This modernization was in line with the Bureau's policy to maintain all departments in naval hospitals at the highest point of efficiency, by purchasing the latest and best scientific apparatus for all departments.

From 1932 to 1936 the standard technique employed in our therapy clinic for the treatment of deep seated lesions was 200 KVP, 25 ma. at 50 cm. distance, with 0.5 mm. cu. and 1.0 mm. aluminum, an equivalent of 35.4 (r) units per minute, measured in air, and an estimated tumor dose at 10 cm. depth of 10 percent of the threshold erythema. Quimby (1) of the physics department of the Memorial Hospital, New York, has found that:—the threshold erythema with 200 KVP, 100 sq. cm. field, 50 cm. distance (T. S. D.) and 0.5 mm. copper plus 2.5 mm. aluminium is 500 to 525 roentgens.

The therapeutic erythema, on the other hand, varies from 600 to 1,000 roentgens, depending on the skin type. Failla (2) of the physics department of Memorial Hospital, whose work on the effective wave length of radiation is internationally known, has found that the relative depth doses at 10 cm. depth, obtained under comparable conditions with 200 KVP, 700 KVP, and Gamma rays are respectively 29 percent, 41.2 percent and 56.7 percent. However, the advantage in percent depth dose in favor of radium is not realized in clinical practice because it is not practical to apply radium at the focal distances used in roentgen therapy.

Articles by Quimby (1), Failla (2), Coutard (3), Pack (4), Ruggles (5), and Merritt and Rathbone (6), during the past year, inspired us

with the desire to obtain a greater effective tumor dosage compatible with skin safety. Most observers who have had an opportunity to compare skin reactions and results obtained with 0.5 mm. copper and 2.0 mm. of copper filtration, are convinced of the latter's superiority.

Merritt and Rathbone (7) state:

> Following the work of Thoraeus (8) we have been using at the Warwick Clinic a filter composed of 1.25 mm. tin, 0.25 mm. copper, and 1.0 mm. aluminum. This filter has been used at 220 KVP, 20 ma., 50 cm. distance with an intensity of 10 r. per minute, measured in air. This filter has a maximum wave length of 0.21 Å, which is the same maximum wave length as 5 mm. of copper. Copper absorption curves show that this filter has a half layer value of 2.9 mm. copper at 220 KVP, which is the same as 5 mm. copper at this voltage. This tin filter is very transparent to hard roentgen rays generated at 220 KVP, and gives an intensity 35 percent greater than 5 mm. of copper. With this filter we have found the intensity of 10 r. per minute at 50 cm. distance to be practical and economical in the treatment of selected deep seated malignancies.

With these facts in mind and with the desire to secure the greatest tumor dosage possible in a given case, using the maximum power at our disposal, we have now standardized our technique at 220 KVP and 20 ma., using Thoraeus filters equivalent to from 2 to 5 mm. of copper, at 50 cm. distance, thus increasing the actual tumor dose at 10 cm. depth from 10 percent of the threshold dose to approximately 45 percent, and furthermore, as a result of skin protection resulting from such heavy filtration, it is now possible to deliver from 4 to 10 erythema doses to the tumor, in effect, a dose sufficient to sterilize the growth without permanently damaging the skin and adjacent tissues. The skin reaction may, in the average case be described as a second degree burn, which gradually fades out, with the skin completely restored in from 6 to 8 weeks.

In view of the fact that 28 percent of our series of 107 malignant neoplasms were skin cancers, we have attempted to standardize our method of treatment with due regard to the essential features of each individual case.

Results obtained by surgery, surgery followed by radiation, cautery excision, preceded by or followed by irradiation, or radium, over a period of 4 years, were all considered. Now, due to the brilliant results reported by Dr. Lyell Kinney and Dr. Ray Lounsberry of San Diego, in their private practice, and at the San Diego County Cancer Clinic, we have adopted their method of cautery excision followed by unfiltered radiation, in basal cell lesions, and cautery excision followed by copper filtered radiation in epidermoid carcinomas, with excellent clinical results in every case.

Impressed by the results obtained in the treatment of leukemias, Hodgkin's disease, lymphosarcoma, and multiple myeloma, by continuous irradiation, at the Memorial Hospital, New York, we have modified Heublein's technique to fit our equipment, so that we are able

to spray our patients at a distance of 115 cm., using 200 KVP, 0.5 mm. cu. and 1.0 al. filter, with an intensity of 5 r. per minute, measured in air. Heublein cites as possible advantages of his method:

(1) The nearly uniform distribution of the rays throughout the body, in treating generalized neoplasms.

(2) The possibility that great protraction of treatment would make possible the irradiation of all the tumor cells during their period of mitosis, when they are most sensitive.

(3) The assumption that despite the protraction of treatment, the intensity of radiation affecting any given cell would nevertheless remain sufficient to sterilize it.

In the small series of cases that we have treated so far, we are inclined to believe that this method is superior to any heretofore attained in the treatment of chronic lymphatic leukemia. Favorable results have also been obtained in the treatment of Hodgkin's disease.

RADIUM

All cases that the cancer board decides should be treated by either contact or interstitial radium, due to the location or character of the lesion, are so treated. Having obtained the necessary authority from the Bureau of Medicine and Surgery to defray the necessary expense, the case is referred to a civilian radium therapist for treatment. This method, in use during the past year, has proved entirely satisfactory to the board, and the results obtained have been excellent.

CONCLUSION

A review of the Surgeon General's report covering the 5-year period from 1931–35, and of the San Diego Naval Hospital Cancer Clinic from 1936–37, would tend to show that the incidence of malignant neoplasms in the fleet per 100,000 has remained relatively the same, and compares favorably with the rate per 100,000 in the same age groups in civil life.

The present method of disposition and treatment of cases has proven to be eminently satisfactory, both to the patients and to the service.

By the use of filtration equivalent to from 2 to 5 millimeters of copper, at 220 KVP it is believed that with such filtration inoperable intra-abdominal tumors can be brought into the field of radiotherapy.

A permanent cancer board, with full power of function, is of vital importance in the successful treatment of malignancy.

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CARCINOMA OF THE LUNG

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The startling increase in incidence of carcinoma of the lung encountered in the past 3 years has prompted this attempt to summarize the outstanding features of this serious disease, with emphasis on the roentgenologic diagnostic features. In contrast to the relative rarity of the condition a decade ago, when it was an uncommon autopsy finding and diagnosed antemortem in only about 5 percent of cases, lung carcinoma now comprises from 6 to 8 percent of all carcinomata and stands next in frequency to malignancy of the gastro-intestinal tract. At the Philadelphia General Hospital, which admits both sexes and all ages in about proportionate numbers, it is now the most frequently encountered malignancy. At the United States Naval Hospital, Philadelphia, in 218 autopsies performed in the past 2 years there were 52 cases of malignancy of which 10 were carcinoma of the lung, an incidence of 19 percent of all malignancies and 4.5 percent of all autopsies. These figures, of course, are not representative of the general population because of the large admission rate of veterans in the cancer age, but it serves to emphasize the incidence of the condition in males of this age group and proves its importance to the naval medical service.

ETIOLOGY

The etiology at present is largely a matter of conjecture. The great preponderance of males to females may be significant, being approximately the ratio of 10 to 1. Negroes appear to be less susceptible than whites. Approximately 75 percent of cases occur between

the ages of 41 and 60, altho, cases between 20 and 30 are not uncommon. The hazard appears to be increased in industries involving inhalations of irritating dusts and fumes. It does not appear however, to be an especially frequent sequel of pneumoconiosis. In the cases reported in the literature there does not appear to be a convincing relationship to the smoking of tobacco. The continuous irritation of the respiratory mucous membranes by exhaust and industrial fumes in our modern life appears a plausible cause.

PATHOLOGY

Practically all primary carcinoma of the lung is bronchogenic in origin, arising in the main bronchi, their branches, or in the terminal bronchioles. Both lungs are about equally involved and the upper lobe bronchi about as frequently as the lower. The primary lesion may be pedunculted, sessile, or ulcerative. Classified according to malignancy, grades 3 and 4, Broder's, greatly predominate. Histologically the squamous cell type predominates; the undifferentiated type, including the spindle, round, and "oat" cell types, are almost as frequent, and adenocarcinoma comprises a small percentage. Extention of the growth takes place by direct contiguity, by retrograde lymphatic permeation, by lymphatic metastasis to the peribronchial and thence to the hilar periaortic and abdominal lymph nodes, and by the blood stream to all parts of the body. Peripheral growths reaching the pleura rapidly involve the serous surfaces, studding the parietal pleura, especially with flat nodular secondary implantations. Contralateral pleural involvement is common. Subserous metastases to the abdomen may involve extensively the peritoneal surfaces. Hematogenous metastases involve especially the brain, bone, and the heart. The bone lesions are osteolytic.

Pulmonary suppuration is the outstanding pathologic feature in many cases. Obstruction of the bronchi results in stasis of secretions beyond the stenosis with secondary infection, giving the picture of bronchiectasis or multiple abscesses. Abscess formation is also frequently due to central necrosis of the tumor mass with secondary infection. Death occurs as a result of cachexia, long-continued secondary pulmonary suppuration, hemorrhage, or from metastatic lesions to brain or heart.

SYMPTOMS

Symptoms due to the primary lung lesion are quite constant and rather suggestive. The onset is insidious, the symptoms existing usually 4 to 8 months before becoming so severe as to lead to a thorough physical examination. Many cases present the symptoms of an acute respiratory infection at the start, from which recovery does not take place normally, or intermittent periods of apparent well-being

may take place for some time. Many cases are diagnosed unresolved pneumonia, abscess or bronchiectasis due to failure of a supposed infection to resolve normally. Cough, either productive or dry and brassy, is present in over 80 percent of cases. Pain, in the chest, or referred to back or shoulder, occurs in over 60 percent, may be dull, aching and constant, or severe and paroxysmal. Pain may be increased on percussion over the involved portion of the chest, a suggestive sign. About one-half of the cases complain of dyspnea and it is most marked in cases with massive pleural effusion or with tracheal compression from gross glandular metastases. Hemoptysis occurs in 40 to 50 percent; it may consist only of blood streaking of the sputum or of gross or even fatal hemorrhage. The temperature is elevated in approximately 30 percent, which, along with misleading physical signs, frequently leads to be erroneous or incomplete diagnosis of chronic pneumonia, abscess, or tuberculosis. Night sweats and hoarseness are not uncommon. Clubbing of the fingers is reported in about 15 percent of cases. In addition there later occurs the usual findings of malignancy, weight loss in 50 to 70 percent, loss of strength, pallor, secondary anemia, etc.

Frequently, however, the primary lesion causes few early symptoms and the first symptoms are due to metastatic lesions elsewhere in the body. The primary site may be entirely overlooked for long periods or may be first detected by routine chest roentgenograms. In the absence of pleural involvement or of gross bronchial obstruction the primary lesion may grow to considerable size without prominent symptoms. A pathologic fracture may cause the first suspicion of a malignancy. Metastatic brain lesions occur in 24 percent and the lungs should be considered as a primary source in this type of case. Gastro-intestinal symptoms from metastatic lesions may simulate the symptoms of peptic ulcer or primary gastric malignancy. Jaundice may occur from liver involvement and dysphagia from erosion into the oesophagus.

PHYSICAL FINDINGS

The physical findings are exceedingly variable depending on the location of the tumor. In general, most cases may be grouped into three types: The lobar type, the hilar and the nodular. In the lobar type a large bronchus becomes obstructed by the growth with resulting atelectasis of a whole or part of a lobe. Malignant invasion tends to occur more rapidly into the collapsed lung with progressive replacement by tumor tissue. There is dullness on percussion over the atelectatic and infiltrated lung; breath sounds are absent as a rule. Voice sounds and fremitus are usually decreased or absent. Rales may be noted.

In the hilar type the growth may attain considerable size without entirely blocking a bronchus, the growth breaking through the

bronchial wall and infiltrating widely into the surrounding tissue. Atelectasis tends to occur later. The physical signs may be disproportionately slight compared with the extent of involvement. The partial obstruction may cause asthmatoid wheezes; rales are frequent. The para-vertebral dullness may be perceptibly widened on percussion. However, the remainder of the lung may be normally resonant and voice sounds very little impaired. At times emphysema may be present for a while on the involved side due to partial obstruction, especially in the expiratory phase.

The nodular type is a more or less circumscribed type toward the lung periphery and when involving only a small bronchus or bronchiole may cause but slight atelectasis and, when normal lung is present between chest wall and the tumor, auscultation and percussion may fail to reveal any evidence of the lesion.

Most carcinomata of the lungs eventually involve the pleura, either by extension or metastisis. The findings of pleural effusion are then present. The fluid on tapping is usually sero-sanguinous and tumor cells may be discovered upon microscopic examination.

Metastasis to the mediastinal nodes leads to progressive dyspnea, frequently causes venous congestion due to pressure on the vena cava, and oftentimes dysphagia due to pressure on the oesophagus. The paravertebral dullness tends to be widened.

Evidence of pulmonary suppuration commonly develops due to stasis of secretion in the tracheo-bronchial tree peripheral to the stenosis followed by bronchiectasis and abscess formation. Frequently central necrosis of the tumor mass occurs with expectoration of large amounts of fetid pus and blood. Evidence of cavitation may be elicited. Fragments of tumor tissue may be detected by microscopic examination of the sputum. Rupture of a large vessel may result in rapidly fatal hemoptysis.

Supraclavicular nodes may be enlarged due to metastasis. Diaphragmatic palsy due to involvement of the phrenic nerve in mediastinal metastasis is common, as is also laryngeal paralysis due to involvement of the recurrent laryngeal nerve. Horner's syndrome may be observed when the sympathetic system is involved.

The roentgen findings are bizarre in their variability and in appearance. In the lobar type there is progressive atelectasis of a part or whole of a lobe. The opacity diminishes toward the periphery and at the apex and is densest about the hilum. A hard film may demonstrate two superimposed densities, the inner due to tumor mass with usually a ragged irregular outline, the outer lesser density being cast by the surrounding atelectatic lung. The heart, trachea and mediastinum are displaced toward the side of the lesion; the diaphragm tends to be elevated and the interspaces usually narrowed. I have however seen a number of advanced cases with displacement of the

mediastinum toward the lesion while the interspaces were widened. I have seen this in no other lesion and consider it diagnostic. A marked pleural effusion with displacement of the mediastinum toward that side is also peculiar to the condition. It may be due to fixation of the mediastinum by infiltration after the mediastinum has migrated following atelectasis. Progressive growth or massive effusion following this fixation of the mediastinum may cause widening of the interspaces or even intercostal bulging.

In the hilar type a dense mass is present in the hilus, usually roughly semicircular in shape with sometimes a rather regular, sharply defined outline, but more commonly ragged and irregular, poorly defined with strands of infiltration into the surrounding lung. A variant of this type occurs when the primary mass is small and obscure but extensive lymphatic permeation has occurred throughout the lung fields causing a generalized coarse reticulation resembling pulmonary fibrosis or bronchopneumonia. A beading at the points of intersection may simulate miliary tuberculosis. Relatively large lesions near the bifurcation of the trachea may be entirely obscured by the heart and mediastinum and no charges may be evident on the film until gross glandular enlargement or atelectasis takes place.

The nodular type usually forms fairly distinct, rounded or triangular shadows at the apex or toward the periphery of the lung. There is little or no surrounding atelectasis and the shadows have no surrounding zone of pneumonitis which helps to differentiate them from tuberculosis lesions and abscess. The outlines may be regular and sharply defined or ragged, irregular, and indistinct. Upper lobe lesions are usually free of complicating pleural effusion until late in the coarse and are the easiest to demonstrate.

Glandular enlargement at the hilus and mediastinum may occur early with little evidence of the primary lesion and carcinoma must be considered in the differential diagnosis of mediastinal gland involvement in the cancer age. The opposite hilus may also be prominent and nodular due to glandular metastasis. Metastasis to the heart and pericardium is frequent and may cause a marked irregularity or nodular appearance of the cardiac silhouette.

Pleural effusion is a frequent and annoying development and by masking the lung fields makes the diagnosis difficult and at times impossible. Bronchogenic carcinoma should be considered in the differential diagnosis in every case of pleural effusion in an adult. The fluid reforms extremely rapidly after withdrawal, but, when replaced by air, a roentgenogram taken immediately may reveal the underlying pathology and is of great aid in diagnosis. Effusion occurs much less commonly with upper lobe lesions. In these cases, however, pneumothorax may also give aid in delineating the outline of the tumor mass and also demonstrate the presence or absence of

pleural adhesions and probable chest wall involvement, an important factor in prognosis.

Bronchography by intratracheal instillation of lipiodol may show the exact site of broncheal obstruction or may only show failure to enter a certain portion of the lung. I have repeatedly seen the latter phenomenon in early pulmonary abscess before it communicates with a bronchus and I have not been able to distinguish the appearance between the two conditions except where a definite bronchial block can be demonstrated. At times this blockage is sharply defined and definite and the margins of the intrabronchial defect can be made out.

Abscess due to central necrosis of lung carcinoma usually is rather characteristic with a dense surrounding zone of infiltration with ragged, irregular outer margin of the mass. There is lacking the soft shadow of surrounding pneumonitis seen in simple abscess. Except where complicated by a coexisting tuberculosis the fibrotic or exudative infiltrations of that disease are lacking. The cavity usually presents a fluid level, tending to differentiate it from a tuberculous cavity. A differential point of value is that displacement of mediastinum and trachea seldom occurs with simple abscess, frequently with carcinoma.

Abscesses secondary to obstruction occur especially in the lower lobes and are frequently multiple. There is nothing characteristic about their appearance but a tumor mass may be demonstrable between the abscesses and the hilus or bronchography may reveal blockage of the bronchus to the involved area At other times a typical picture of bronchiectasis may be obtained. Serial observations reveal an abnormally rapid progression of the lesion, however, and should suggest the cause.

Obstruction due to foreign body aspiration produces effects indistinguishable by the roentgenogram but the history of abrupt onset, coughing and choking, is usually obvious and bronchoscopic examination reveals the cause.

Associated roentgen findings frequently found are diaphragmatic palsy due to involvement of the phrenic nerve, evidence of osteolytic metastatic lesions of bone, compression of the oesophagus by the mass or enlarged glands demonstrated by swallowing of barium, and at times erosion of the ribs adjacent to the involved lung.

DIAGNOSIS

An antemortem diagnosis was made 10 years ago in only about 5 percent of cases. Today as high as 50 to 75 percent are correctly diagnosed. The percentage of cases so diagnosed will depend upon the index of suspicion and the degree of cooperation between clinician, roentgenologist, pathologist and bronchoscopist, all of whom contribute by their peculiar approach to the problem. Bronchogenic carcinoma should be suspected in any adult, especially over the age

of 45, with progressive cough, pain in the chest and hemoptysis. Pleural effusion should be suspected when other cause is not obvious and the lung should be considered as a primary locus in metastatic malignant lesions, especially of the brain and mediastinum. The greatest responsibility lies with the radiologist, who may detect an unsuspected or asymptomatic primary lesion on routine chest examination. All suspicious appearing chests should be subjected to bronchoscopy. Biopsy by this means clinches the diagnosis in the majority of cases except those near the lung periphery. Roentgen findings of particular significance are atelactasis with displacement of the mediastinum heart, and trachea to the side of the lesion. Farrell (6) goes so far as to state:

> Whenever evidence of pulmonary collapse is detected in an adult, one should consider it as due to bronchial occulsion of neoplastic origin until the presence of neoplasm has been excluded.

A progressive bronchiectasis should also be regarded with suspicion. Serial roentgenograms should be taken in all suspicious cases. A dense, thick-walled single cavity without frank evidence of tuberculous origin should always be considered neoplastic until proven otherwise.

Microscopic examination of all hemorrhagic pleural exudates will reveal neoplastic cells in a large percentage. Lung puncture for diagnostic material has not been so successful. Biopsy of enlarged supraclavicular nodes when found gives a high frequency of involvement and aids in diagnosis.

The differential diagnosis is concerned primarily with metastatic malignancy of the lung from a primary lesion elsewhere in the body, infectious processes of the lung and pleura, and neoplasms arising primarily in the mediastinum and involving the lung secondarily. The most frequently encountered mediastinal lesion which is difficult to differentiate is Hodgkins disease. Primarily the lesions are distinctly nodular, confined to the glandular structure with fairly well-defined, lobulated widening of the mediastinum. However at times it breaks from the confines of the glandular structures, assumes a distinctly invasive character into the hilar structures and at times radiating into the lung via the lymphatics, making differentiation very difficult. Biopsy of involved peripheral glands allows a microscopic diagnosis when these are enlarged, but many cases are confined, at least for awhile, to the mediastinum. Moreover metastatic lesions to bone may be impossible to differentiate by X-ray although biopsy of the bone will reveal its true nature. Intrathoracic thyroid adenoma may resemble neoplasm at first appearance but there is usually thyroid enlargement in the neck; the intrathoracic mass moves upward upon swallowing or grunting when seen under the fluoroscope. I have recently seen a case diagnosed as carcinoma of lung due to

parenchymal neoplastic involvement of the lung which upon necropsy showed a small primary lesion in the thyroid. This type of involvement in the chest is rare. Tuberculous adenitis of the mediastinum may at times cause a dense shadow at the hilus simulating neoplasm and in a case recently seen caused atelectasis of the lower lobe due to compression and occlusion of the lower lobe bronchus and an erroneous diagnosis of bronchogenic carcinoma was made. Bronchoscopic examination in such a case will reveal the obstruction as due to extrinsic pressure and the true nature may be surmised.

Thymomas arising from the mediastinum may protrude into the lung fields but are circular in outline, sharply defined, and are homogenous and much less dense than carcinoma. They are characterized by extreme sensitivity to X-ray irradiation. Reticulum-cell sarcoma may invade the lung, tends early to produce pleural effusion and may be diagnosed only by biopsy. It is also relatively insensitive to irradiation.

Advanced cardiospasm with dilatation of the oesophagus produces a bulge of the mediastinal shadow to the right but this has a rather smooth outline and barium meal shows the shadow to be due to a greatly dilated oesophagus. Carcinoma of the oesophagus with ulceration into the left bronchus or trachea produces a mottling at the bases due to aspiration and at times may obstruct the bronchus. The primary complaint of dysphagia and the demonstration of communication of the oesophagus and tracheo-bronchial tree by the fluorscopic ingestion of barium reveals the true nature of the lesion.

Diaphragmatic hernia produces a nonhomogenous opacity at the left base and at times upward almost to the apex. There is also often evidence of fluid at the base. The barium meal shows the opacity as due to herniated bowel in the thorax.

Metastatic malignancy of the lung is usually multiple. The lesions tend to be rounded and more or less circumscribed. There is no surrounding atelectasis and usually no symptoms referable to the chest until late. The hilar glands are not enlarged. The primary lesion may be discovered, usually in the kidney, testes, or thyroid. At times extension of a breast carcinoma through the chest wall may invade the lung parenchyma simulating primary carcinoma due to its invasive character. The history and physical examination however will prevent error in these cases.

Among the infectious processes, pulmonary tuberculosis is the most frequently encountered and can usually be easily differentiated by the history, physical, and laboratory findings and the character of the infiltration. Lung abscess usually has a more abrupt onset with acute febrile course. The roentgen film shows a small abscess cavity with surrounding zone of soft exudative reaction while malignancy is of longer duration with signs of suppuration only later in the course.

However, it must be remembered suppuration is a most frequent sequel of carcinoma of the lung and evidence of it does not aid in excluding malignancy. Abscesses due to advanced Friedlander's pneumonia may present thick walls resembling neoplastic abscesses but are usually multiple and tend to involve both lungs, while culture of the secretion reveals the causative bacillus. Progressive bronchiectatic lesions should always be regarded with suspicion and bronchoscopy resorted to in all cases to rule out a causative malignancy. Chronic pneumonia and the progressive fibroid pneumonias are rather rare and many so diagnosed are found at autopsy to be due to carcinomatous involvement of the lung.

Primary neoplasms of the lung, other than bronchogenic carcinoma are rare. Chondroma appears as a sharply rounded opacity with densely calcified center. Primary sarcoma was formerly more frequently diagnosed but reconsideration of many of the cases in the light of what is now known of bronchogenic carcinoma has led in many of these cases to a revision of the diagnosis.

Neurofibromata appear as soft shadows usually obviously arising from the vertebral margin, are quite distinctly outlined, and not invasive. Diagnostic pneumothorax shows them to be extra pleural and outside of the lung as the latter collapses. Hydatid cyst appears as a sharply outlined circular shadow usually of distinctly less density and calcification in concentric layers is demonstrated at the periphery.

Dermoid cysts are usually seen to arise from the mediastinum, are rounded or oval, sharply defined and thin walled. Layering of the fluid contents can often be demonstrated roentgengraphically.

PROGNOSIS

Surgery appears the best hope of survival at the present time. However, the operative mortality approaches 50 percent and, of those surviving, late evidence of recurrence in the mediastinal glands or of hematogenous metastasis supervenes to a discouraging extent. However, cases free of disease for as long as 7 years after operation have been reported. As in malignancy elsewhere in the body, all efforts must be made to attempt earlier diagnosis and with our increasing knowledge of its characteristics such will undoubtedly be possible in a larger percentage of cases. Death in untreated cases occurs in from 2 months to 7 years. The condition as a rule is slowly progressing and the average case lives about 8 months after the diagnosis is made. The prognosis appears to be somewhat better in lesions involving the primary bronchi where the cartilage appears to have some restraining effect and the cell type tends to be somewhat more differentiated. However, the localized parenchymal lesion before it has involved the pleura tends to involve the hilar glands late and if removed before blood stream metastases take place appears the best surgical risk.

TREATMENT

Lobectomy has been successful in eradicating small localized growths toward the periphery. In larger growths and in all those involving the hilar glands total pneumectomy is required. The shock of operation is less than one would expect. The third interspace is the usual avenue of approach. Ligation of the pulmonary vessels and of the bronchial stump offers some difficulty and effective removal of the glands considerably more. Adherent pleura due to invasion is removed; these cases offer little hope of permanent cure. Later thoracoplasty is frequently necessary to obliterate the cavity. In children and young adults considerable migration of the heart and opposite lung takes place after pneumectomy and may entirely fill the space.

Preliminary pneumothorax is induced before operation to determine the presence of adhesions and the involvement of the chest wall and pleura, to more accurately delineate the outlines of the tumor and also to stabilize intrathoracic pressure and thus decrease operative shock. After operation the chest wall is tightly closed and pneumothorax reinduced with slight positive pressure to prevent mediastinal fluctuation and also exert pressure on the bronchial stump and ligated vessels. This tends to decrease postoperative hemorrhage and decreases the postoperative pleural exudate which invariably follows operation. This must be removed by aspiration if too extensive; if infection follows siphon drainage must be instituted. Preliminary irradiation of the chest is of doubtful value and appears not to warrant the loss of time involved.

Roentgen irradiation has been very disappointing up to the present. However the cases have almost all been advanced and possibly if earlier lesions are treated by the Coutard technic better results may be obtained in the future.

Bronchoscopic implantation of radon tubes has been successful in removing the primary growths in small especially pedunculated lesions which protrude into the bronchial lumen, and offer a method of approach combined with irradiation where operation is not feasible.

In inoperable cases little can be done except nursing care and opiates. Bronchoscopic drainage is advised when suppuration supervenes, especially if irradiation is given.

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BRONCHOGENIC CARCINOMA

WITH METASTASES TO HEART AND PITUITARY

CASE REPORT

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A generation ago carcinoma of the bronchus was considered a rarity. At that time most of the malignancies of the lung were considered to be metastatic from a primary growth in some other organ. Today it is estimated that about 5 percent of all carcinomas arise primarily in a bronchus (1). Metastasis from this primary site may occur to any organ in the body. In a study of 374 cases of bronchogenic carcinoma, Adler (2) found the metastases were distributed as follows: Bronchial lymph nodes, 117; liver, 103; kidney, 58; bones, 57 (in the order of ribs, spine, skull, and sternum); brain, 53; pleura, 52; pericardium, 39; adrenals, 38; heart, 30; tracheal lymph nodes, 26; cervical lymph nodes, 23; retroperitoneal lymph nodes, 23; spleen, 18; and voluntary muscles, 9. Other organs found less frequently involved by metastases were skin, nasal septum, eye, urinary

[1] These references furnished the essential source material for this article.

bladder, fallopian tubes, ovary, uterus, pancreas, thyroid, spinal cord, and pituitary gland. Metastases were absent in 33 cases.

The following case of bronchogenic carcinoma is reported because metastasis occurred to two of the organs less frequently involved—to the heart and to the pituitary gland. As is usual in cases of metastasis to the pituitary gland (3) there was an associated diabetus insipidus.

CASE REPORT

The patient, a white male aged 41, was admitted to the United States naval hospital, Chelsea, Mass., on July 31, 1936, for treatment of what he stated was a lung abscess that had been present for 1 year. The chief complaints on admission were cough with purulent expectoration, excessive thirst with the passage of much urine, and pain in the back of the neck in the region of the fifth cervical vertebra. The patient gave a history of having had pneumonia in 1934 with complete recovery, and dated the onset of the present cough and expectoration to a mild respiratory infection that had occurred in May 1935. Cervical pain had been present for 3 months and excessive thirst and the passage of large amounts of urine for 1 month prior to admission. There had been a weight loss of about 15 pounds the past year.

Physical examination revealed a pale middle-aged man acutely ill. There was dullness to percussion over the lower left lobe of the lung with diminished breath sounds and occasional moist rales. The blood pressure was 100/64. The heart was not enlarged, there were no murmurs, and the rhythm was normal. On palpation, the liver was found to be enlarged to the level of the umbilicus and was definitely nodular. There was marked tenderness over the lower cervical vertebra and the neck was held rigidly. The reflexes were normal.

The Kahn blood test was negative, and urinalysis was negative aside from a low specific gravity varying in different specimens from 1.001 to 1.004. The white blood count was 21,700, with polys, 87 percent; lymphs, 6 percent; large monos, 5 percent; and eosins, 2 percent. The red blood cell count was 3,350,000 with a hemoglobin of 70 percent (Tallquist). The sputum showed no tubercle bacilli, but at times contained elastic fibers. The sedimentation index was 31 millimeters in 1 hour. X-ray of the chest showed an indefinite shadow at the left base partially obscured by the heart. X-ray of the cervical spine showed complete destruction of the fifth cervical vertebra by what appeared to be a metastatic tumor. Stereoscopic plates of the skull showed an enlarged sella turcica with destruction of both the anterior and posterior clinoid processes on the right side.

The patient went down hill rapidly, running a septic temperature from 99° to 104°. There was excessive thirst and polyuria which was relieved by pitressin given hypodermically in 1 cubic centimeter doses several times daily. Several days after admission there was noted a drooping of the right eyelid and dilation of the right pupil. Neurological examination revealed no other pathological findings referable to the central nervous system. Examination of the eye showed no contraction of the visual fields and the fundi were normal. The patient became comatose and died August 23, 1936, 23 days after admission.

Although a bronchoscopic examination was not performed, the diagnosis based on clinical and laboratory findings was bronchogenic carcinoma, with metastases to the liver, fifth cervical vertebra, and to the brain in the region of the pituitary gland.

Autopsy performed by W. M. S. showed the following findings:

Left lung.—Was densely adherent to the diaphragm. There was a mass about the size of a large walnut near the hilum in the upper part of the lower lobe. On

section a constricting new growth was found, having its origin in the left descending bronchus, 0.5 inch from the bifurcation, and which had all but closed the lumen. The tumor mass was confined to this area, no other masses being found in either lung. The lung parenchyma, peripheral to the tumor, was atelectatic and gangrenous, and contained small multiple abscesses which exuded thick foul-smelling pus.

Microscopical examination of the primary lesion showed a tumor arising from the bronchial mucous membrane, practically closing the lumen, and extending through the wall into the lung parenchyma. The cellular structure was that of a fairly well-differentiated squamous cell with large irregularly shaped hyperchromatic and vesicular nuclei and abundant pink staining cytoplasm. Actual intercellular bridging could be observed. The cells were arranged in sheets of varying sizes separated by a fibrous stroma containing lymphocytes. Fairly well-developed epithelial pearls were present. Mitosis was not a prominent feature.

The lung parenchyma beyond showed a severe degree of secondary infection, there being many areas of abscess formation, and most of the bronchioles were filled with pus cells.

Lymph glands.—There were many enlarged mediastinal and mesenteric lymph glands, some as large as golf balls. The structure of these glands was destroyed by tumor growth.

Heart.—An oval shaped firm tumor mass was found in the posterior lateral wall of the right ventricle, the upper edge of which encroached upon the right coronary artery about 2 centimeters from its orifice. It was 4 centimeters in greatest diameter and occupied practically the whole thickness of the ventricular wall. It could readily be seen from the endocardial surface as whitish in color. Microscopical section revealed a cellular structure resembling the primary tumor. That portion of the coronary artery adjacent to the neoplastic growth was completely occluded by tumor tissue.

Liver.—Was three times normal size and was studded with innumerable tumor masses of all sizes up to that of a walnut. The right lobe was practically one solid tumor mass. Microscopical examination revealed widespread metastasis to the extent that it was difficult to recognize the tissue as liver.

Pituitary gland.—This organ was enlarged to about three times average size, the right side showing more enlargement than the left. It had eroded into the sphenoidal sinus. There was also erosion of both anterior and posterior clinoid processes. Microscopical examination showed little normal pituitary tissue remaining, the gland being largely replaced by sheets and masses of metastatic cells.

Fifth cervical vertebra.—The body of the fifth cervical vertebra consisted of soft boneless tissue, which when removed, left only a thin shell of bone along the upper posterior margin connecting the two lateral processes. Microscopical examination revealed tissue resembling the primary tumor.

DISCUSSION

This case is of interest clinically because it illustrates how a lung abscess occurring secondarily to a carcinoma of the bronchus may obscure the primary lesion. When this patient presented himself for diagnosis the carcinoma had occluded the bronchus to such an extent that there was atelectasis of the area supplied by the bronchus with secondary pyogenic infection resulting in multiple abscess

formation. There was not complete occlusion as there was a moderate amount of purulent sputum which on microscopic examination showed the presence of elastic fibers. This secondary purulent infection had been present for at least a year and had given rise to a diagnosis of lung abscess. In the presence of chronic purulent pulmonary disease the presence of carcinoma of a bronchus must always be suspected (4, 5). Vinson (4, 5) states that neither the history, physical examination, nor X-ray appearance are sufficient to distinguish carcinoma of the bronchus from chronic pulmonary disease. He makes the interesting observation that distant breath sounds over the affected lung area is the most important physical finding of carcinoma of a bronchus and states:

> This finding is noted rarely in other pulmonary diseases without involvement of the pleura and when it is observed without corresponding impairment of the percussion note over the area involved, carcinoma should be suspected at once.

This case is also of interest because of the unusual metastases. The sympton of diabetus insipidus was readily explained when at autopsy the pituitary was found to be greatly enlarged by a metastatic growth which completely replaced the normal gland structure. Metastatic lesions of the pituitary are not extremely rare (6). When metastasis occurs in the posterior lobe of the pituitary it usually gives rise to the clinical signs of diabetus insipidus (3). Indeed Fink (3) goes so far as to state that when diabetus insipidus develops in a case of malignancy it is an almost pathognomonic sign of metastasis to the posterior lobe of the pituitary gland. This author in a review of the literature in 1928 was able to find reports of 107 cases of diabetus insipidus in which necropsies had been performed; of this number 16 were due to metastatic lesions of the pituitary. In reviewing the literature since 1928, we have found the following authors who have reported cases of malignancy with metastasis to the pituitary gland: Grossman (7), Benhamon, Montpellier, and Curtillet (8), Johnson (9), Arnstein (10), and Macchioro (11). These matastatic tumors may arise from any organ, but from a survey of the literature seem to arise with greatest frequency from primary growths of the breast and bronchus.

The finding in this case of a metastatic nodule in the wall of the myocardium was unexpected, as there had been no history of cardiac pain or symptoms referable to the heart. The nodule was 4 centimeters in greatest diameter and had completely occluded the right coronary artery. The occlusion had apparently taken place gradually with development of collateral circulation from branches of the left coronary artery and from those of the right above the site of occlusion, as there were no signs of cardiac infarction. It is unfortunate that an electrocardiograph had not been taken to compare the electrocardiographic findings with this interesting anatomical lesion.

Metastatic tumors of the heart occur with greater frequency than is ordinarily believed. Blumensohn (12), in a review of 1,078 cases of

carcinoma in general, found cardiac metastasis in 34, or 3.17 percent, while of 160 cases of sarcoma, 12, or 7.5 percent, showed metastasis to this organ. These metastatic lesions arise with greatest frequency from primary or secondary intrathoracic neoplasms (13) viz lung, pleura and mediastinal lymph nodes, and are probably best explained by retrograde extensions to the heart from the tracheobronchial nodes which also drain the lungs and pleura and in the case of the pericardium by direct implantation (14).

Cardiac mètastasis even though involving large areas of the myocardium may occur without clinical symptoms (15) as in this case. This illustrates the great functional reserve of the myocardium. When symptoms do occur the prevalent symptoms are cardiac pain and cyanosis associated with frequent recurrent hemorrhagic pericardial effusion (16).

SUMMARY

A case of bronchogenic carcinoma is reported with metastasis to the pituitary gland giving clinical symptoms of diabetus insipidus and metastasis to the myocardium with complete occlusion of the right coronary artery without the production of cardiac symptoms.

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CLINICAL NOTES

KRUKENBERG'S SPINDLE

By RAYMOND W. HEGE, Lieutenant, Medical Corps, United States Navy

In 1898 Krukenberg made a report of cases of an anomalous pigmentation of the cornea. The special characteristics of the cases reported were as follows: An oval-shaped brownish pigment deposit on the posterior layer of cornea of both eyes, arranged in a vertical direction. His patients were myopes, females, and over 45 years of age. He believed that the pigmentation was the result of a fusion of the pupillary membrane with the cornea in fetal life.

Edgerton in 1829 made an extensive search of the literature and his report discloses 37 such cases with slight variations from the originals reported by Krukenberg. The variations included cases, in hyperopes, in males, with one eye involved, in which the pigmented spindle was in the horizontal position, and in patients as young as 22 years of age. However, these variations were in the minority. Edgerton's review of the literature included reports made by 22 authors. The greatest number of cases reported by any one author was six, made by Augstein in 1912. His 6 cases were seen among 12,000 patients examined.

A further search of the literature after Edgerton's report discloses the following cases reported: Srinivasan, in the British Journal of Opthalmology, November 1930, reported one case. Ardwell in January 1930 presented a case report at the Royal Society of Medicine of London, and Doggart reported a case to the same society, March 1930.

Several theories as to the origin of the condition have been propounded. Some authors accepted the pupillary membrane fusion theory of Krukenberg. Stock thought the cells of the posterior layer of the cornea possessed some anomalous pigment developing power.

Koby in 1927 reported observing the development of typical spindles in a patient with iritis 4 months after an infection and a second which developed from a few dots of pigment into a complete spindle in a period of 18 months. He believed that the spindle-shaped pigmentation was due to breaking down of the pigment of the iris, facilitated by such condition as myopia, senility, and chronic inflammation, and he believed convection currents resulting from tempera-

ture changes carried the pigment to the cornea, where it was deposited. In cases with existing inflammatory condition the pigment was deposited rapidly, but if the inflammatory condition was absent the deposition was slow and dependent upon scratching of the cornea by the granules of pigment carried by the convection currents. Other theories have been proposed to explain the origin of this rare condition and are referred to in Edgerton's report.

REPORT OF A CASE

Patient LWF, fireman third class, United States Navy, age 28, male, was admitted to United States naval hospital, Washington, D. C., March 4, 1936, with diagnosis *Dementia praecox*. The original diagnosis was made August 13, 1935, when admitted to Mare Island Hospital, California. History disclosed that patient had worn glasses for past 2 years at intervals for double vision. There was no history of eye disease. Glasses did not improve vision and he discarded them recently. Vision 20/20 either eye on entry into the naval service. No history of eye diseases in family. General physical examination was negative except for psychological and neurological findings and marked gingivitis and pyorrhea, alveolaris. Weight 130 pounds, and height 68 inches. An examination of the eyes revealed the following: No evidence of acute or chronic inflammatory disease. The color of iris is brown. VOD 20/20, VOS 20/30. Color vision normal. Visual and color fields, right eye normal; in left there was concentric contraction of visual and color fields and interlacing of colors. Under homatropine VOD 20/15, VOS 20/15. During the retinoscopic examination, bilaterally, a vertical elongated shadow was noted which did not move with the retinal shadow. The opthalmoscope showed this to be a brownish pigmentation of the cornea extending in the vertical direction, opposite the pupillary opening. This pigmentation was about 5 millimeters in length and 2 millimeters in width, each eye, and appeared tapered toward each end. The opthalmoscopic examination was otherwise negative. Neutralization of the patient's glasses showed them to be OD 0, OS 3D prism, base down. An examination by the phorometer revealed at 6 meters esophoria 0, exophoria 0, left hyperphoria .2D and at 33 centimeters, 8D exophoria. An examination with the slit lamp disclosed the pigment to be in the posterior layer of the cornea. The pigment had a brownish appearance identical to that seen among the muscle bundles of the iris. The pigmentation was more extensive than it appeared to be on examination with the opthalmoscope, for scattered particles were seen over the greater part of the cornea. On the lower and mesial aspects of the cornea it extended as far as the limbus. These deposits were more numerous toward the center where they were sufficiently dense to show macroscopically as described above. No pupillary membrane or other anomalies were noted.

Laboratory tests: Kahn and Wassermann negative. Urine negative. White blood cells 14,000, neutrophiles 69 percent, lymphocytes 22 percent, eosinophiles 3 percent, monocytes 6 percent. Sedimentation time, 8 millimeters in 60 minutes.

SUMMARY

1. Krukenberg made the first report of cases of this condition in 1898, reporting three cases in that year. Since that time 26 authors have reported 41 cases of this condition.

2. Several theories as to the origin of the pigmentation have been propounded.

3. A typical case is reported with the following characteristics:

(a) Vision slightly impaired.

(b) There is a brown, oval-shaped pigmentation of the cornea, both eyes, vertical in direction and central in position, seen macroscopically.

(c) Examination by means of the slit lamp shows the pigmentation to be in the posterior layer of the cornea, involving the greater part of the cornea. Below and to the nasal side the pigmentation extends as far as the limbus. The pigment is more concentrated as the center is approached, where the spindle or deep pigmentation appears macroscopically.

(d) On refraction the eyes are emmetropic.

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DENTAL NEUROSIS

By V. A. LeClair, Lieutenant, Dental Corps, United States Navy

Impacted teeth cause subjective neuralgic symptoms, in many cases, where a lobical explanation of these symptoms cannot be given. It is problematical if all the conditions existing that are apparently caused by the teeth can be directly traced to the teeth. The following is a report of two cases that fall in this category:

Case 1.—D. H. C., seaman, second class, age 25 years, married, white male.

Chief complaint: Pain in the ear and "cold in the eye." Noticed eye would not close. Shipmates accused him of being a "wise guy" by talking out of the left corner of his mouth.

Past history: Scarlet fever and diphtheria at the age of 8 and measles at 10. Uses alcohol sparingly.

History of present illness: Three days prior to reporting to sick bay he started to talk out of the corner of his mouth. The night before he reported he felt pain for the first time in his ear and attributed the pain to a "blackhead" in the ear. The day after the pain appeared the eye commenced to water freely. Three days before onset of illness the patient drove about 240 miles round trip in a roadster with windbreakers. These trips were weekly events prior to this period. Two days after this trip he developed accentuated talking out of the side of his mouth, lacrymation right eye and slight pain in the ear, and reported to the sick bay where he was treated by the duty corpsman for a cold in the eye. The following day, April 18, he was admitted to the sick list with a diagnosis of Bell's palsy.

Physical examination: A well developed white adult male. Rhomberg negative, no conscious stiffness of the face, pupils equal, react to light and accommodation. Ear normal, taste normal. All muscles of expression on right side of the median line of the face completely paralyzed. Phlegmatic, all muscles supplied by the facial nerve on right side involved. The wrinkles of the forehead and nasolabical fold, on the right side, flattened out. Deviation of the nose to the left. Inability

to whistle, bare the teeth, or close the eye. Cannot elevate the right eyebrow, cannot drink water without drooling. No pain on deep pressure in the styloid region or behind the ramus of the jaw. Oral cavity normal.

Treatment: Patient remained on the sick list for 2 weeks with no apparent improvement. X-ray examination of the oral cavity disclosed the upper right wisdom tooth horizontally impacted, with the occlusal surface flush with the crest of the alveolus. No clinical, radiographical, or palpable signs of pathological involvement. May 1, the upper wisdom tooth was removed under local anesthetic, taking care to cause minimum of trauma. The following day, the right eyebrow showed evidence of movement. Four days later the patient could whistle and bare his teeth. One week from the date of operation the patient was apparently normal and has remained so to date.

Case 2.—C. R. E., Lieutenant, U. S. N. age 31 years, married, white male, medium size and build.

Chief complaint: Aggravating pain behind ear with an inability to raise voice above normal tone without loss of sound.

Family history: Father died at the age of 67, mother living and well. Three sisters all living and in good health.

Past history: Chickenpox at 8 and scarlet fever at the age of 10. Appendectomy and herniotomy in 1925. Health record in Navy negative. About January 1932 he first noticed a slight aggravating pain on the left side of the face in the region of the submaxillary gland. These symptoms came on intermittently thereafter. The symptoms were aggravated and intensified when subjected to a draft as driving a closed car with the driver's window open. These symptoms subsided completely for a considerable time following the first attacks.

Present illness: About a month before reporting for treatment the above symptoms reappeared and progressively became worse, being aggravated by exposure to drafts. September 15, the patient reported to sick bay with pain centered in the ear; bothersome but not clearly defined as to location, with swelling of the submaxillary region on the left side, and complaining of complete loss of voice when speaking in a forceful manner. Combination of intense pain with a sensation it was impossible to talk, comparable to someone grabbing hold of the vocal cords. No soreness of the submaxillary gland. "Like the sensation of a contraction of a throat muscle; when I stopped to clear my throat the impediment would disappear." The speech impediment has been steadily becoming worse. These symptoms are practically constant at the present time.

Physical examination: Mouth normal, excellent oral hygiene. No evidence of clinically demonstratable pathology of the hard or soft tissues. Apices radiographically negative. Considerable swelling of the left submaxillary gland region with tenderness posterior to the ramus of the mandible, anterior to the external auditory meatus. Radiographic examination revealed tooth No. 16 in slight lingual version below the line of occlusion with a super impacted supernumerary third molar lying distally and above the roots of tooth No. 16 in close proximity to the maxillary sinus. No clinical, radiographic, or palpable signs of infection in the area could be demonstrated.

Treatment: On September 16, the normal third molar was removed under local anesthetic. Forty-eight hours after the removal of the tooth symptoms disappeared with no recurrence to date.

It is not assumed that the above cases were definitely caused by the existing dental condition; coincidence must always be considered, however, in view of the complete cures immediately following treatment—they strongly point to a dental origin. Dental literature is full of case reports of widely divergent subjective symptoms of dental origin.

COMMENT

The etiology and nature of the pain caused by impactions is not known. In my opinion, the chain of symptoms is caused by an overstimulation of the vital structures supplying the tooth germ as the roots grow downward into the bone structure. The teeth are found in crypts in the bone, and when they begin to erupt the roof of the crypt is removed by absorption, making room for the crown to pass. The tooth germ remains relatively stationary during the entire growth of the normal tooth. If in the normal growth the tooth becomes impacted, the growth takes place in the opposite direction, causing a disturbance of the physiological balance of that surrounding structure. The capillary and nerve plexes of the tooth germ and the future dental pulps become impinged between the developing tooth and the bone of the maxillae. This disarrangement of the vital structures supplying the tooth causes an overstimulation of these structures producing a conscious recognizable chain of symptoms, or the irritation may be tolerated by the patient. All impacted teeth produce this overstimulation whether subjective symptoms are present or absent.

The degree of tolerance to irritation varies in different individuals; irritation always exists where impactions are present. The reflex nervous conditions of dental etiology oftentimes present no local symptoms and as a result the dental aspect is not considered until all other lines of treatment are exhausted. In the words of Dr. E. Roy Bier, D. D. S.:

> The presence of local or referred pains in or about the head of the patient in the following regions: Temple, back of head or neck, top of head, ears, dull pain around the eyes; or should even a general neurasthenic condition exist, the diagnostician is justified in ordering the removal of any impacted teeth, whether they show infection or not.

PASSIVE ALGOLAGNIA MASOCHISM

By James E. Fulghum, Lieutenant, Medical Corps, United States Naval Reserve, Louisburg, N. C.

This report is made because of the rarity of this type of case outside of the cosmopolitan districts, the rarity of the passive algolagnia in the male, and the unusual type of lesion produced by a patient upon himself.

Algolagnia is divided into two classes, *active* and *passive*. Active algolagnia or sadism is the gratification of the sex urge by infliction or sight of pain real or simulated. This abnormality is found most frequently in the male. Passive algolagnia or masochism is the gratification of the sexual feeling by suffering pain either real or simulated. This is found most frequently in the female. Many

sadists and masochists are potent only when they are subjected to suitable stimuli.

In some instances, sadism and masochism coexist in the same individual; however, one usually overshadows the other. Krafft-Ebling has defined sadism as "an association of cruelty and violence with lust." The condition obtained its name from the notorious Marquis de Sade whose obscene novels treated extensively of lust and cruelty. Masochism obtained its appellation from the writer, Saches-Masoch, who wrote at great length of this form of perversion.[1]

REPORT OF CASE

L. A., a barber, age 25, unmarried, called me to his room in the early morning and asked me to take him to my office. He was standing in his room fully undressed except for a towel which was closely pressed to the genitalia. There were many towels soaked with blood upon the floor which showed evidence of considerable hemorrhage. Upon questioning him, he admitted that he cut his scrotum with the scissors "for the purpose of seeing what his testicle looked like." Immediately, he was taken to the office where a more thorough examination was made. There was an incision about 2 inches long on the left anterio-lateral side of the scrotum through the skin, subcutaneous tissue, tunica vaginalis, and into the testicle. The incision in the skin had been closed by the patient with a needle and cotton thread. These stitches were taken out and a large blood clot removed. The hemorrhage was found to be coming from a severed vein in the tunica vaginalis. Under aseptic conditions the wound was closed in three layers; 1st, testicle, 2d, tunica vaginalis, 3d, skin and subcutaneous tissue, without anesthesia. I explained to him that I could novocainize the wound and he would suffer no pain but he desired to be sutured without anesthesia. There was not the slightest flinching or other outward evidence of pain experienced by the patient.

The wound healed by primary intention without complications, the sutures being removed on the sixth day. Upon close examination, four identical healed scars and numerous pinpoint scars were seen on the scrotum. These former experiences will be discussed in the personal history.

Personal history.—He is the third child born of unrelated parents. His birth was normal and occurred in a small eastern North Carolina town. He has three brothers and five sisters. His preschool days were void of any unusual circumstances except that he never liked to play with other children. He loved his mother better than his father. His school life was normal. He was an average student. His education is limited to the eighth grade and training in a barber college. He took no part in the school social life. He had measles, mumps, whooping cough during childhood but since then, he has had no serious injuries or operations. He does not use alcohol, tobacco, or drugs in any form. His work is satisfactory but he does not enjoy it particularly. He has no recreation except the theater. He has no hobbies nor does he enjoy or play any form of athletics or sports. He has no religious affiliation or interests. He has no friends and when not working he likes to be alone in his room. He does not care for books, music, or current events. He admits that he likes to read sordid and obscene magazines. He was reared in a small town and lived there all of his life except 2 years when he was in school in Baltimore. His sex life has been abnormal. He began the practice of masturbation at the age of 14. He has attempted normal coitus on 2 occasions but could not attain an erection. Erections can be secured

[1] Patten, C. A. "Psychopathic Personality," Cyclopedia of Medicine, vol. X, F. A. Davis Co., 1934.

in his room under suitable stimuli such as pinching himself or sticking himself with pins. The first scrotal operation was done 4 years ago. The others have been done at intervals of several months. One of these done in 1935 was followed by an abscess which had to be opened by his family physician to evacuate the pus. He used no form of antiseptic in these operations. He stated reluctantly that he derived sexual pleasure and gratification from the operations which he had done and that they had been accompanied by erection and ejaculation. He has never seen the same thing done by other people but began to do so because of the pleasure derived at first from pinching the scrotum and later by perforating the scrotum with pins. Girls are disgusting and repulsive to him and make him nervous.

Mental examination.—Negative.

Physical examination.—Well-developed and well-nourished white adult male who shows no abnormal findings except the scrotal wound.

COMMENT

This patient is greatly concerned about himself. He says that he knows that he should not do these things but feels compelled at times to indulge. The fact that he is impotent has increased his worry. He expresses a desire that I help him to overcome these abnormalities, and he has confidence that he can overcome them with the proper help. A supplementary report of the outcome will be made at a later date.

ATYPICAL LOBAR PNEUMONIA

By A. J. Walter, Lieutenant, Medical Corps, United States Navy, and J. L. Holland, Lieutenant, United States Navy

This case is reported as it is believed to be of interest due to the following:

(1) The unusual prodromal signs and symptoms.

(2) The remarkable reaction following the administration of antipneumococcic serum with subsequent rapid disappearance of chest findings.

(3) The clinical course and laboratory findings.

REPORT OF A CASE

Case of J. "T" B.—Patient reported to sick call at 8:30 a. m. complaining of a cold in head and chest of 4 days' duration, also severe occipital headache, stiffness of neck, and general malaise. He stated that 2 days ago he had shore patrol on a cold rainy night from 10 p. m. until 2 a. m., and at 4 a. m. he began his duties in the galley. He stated that the night before admission while at home, he had a severe chill, was nauseated, vomited twice, and had a severe occipital headache which was not relieved by 10 grains of aspirin.

The patient's physical appearance was that of a well developed and well nourished white male of about 26 years of age. He had a distressed look, marked pallor, and appeared quite toxic. The physical findings were not compatible with the above appearance. Temperature and respiration were normal, pulse 90.

Examination of eyes, ears, nose, and throat was negative except for a moderate

nasopharyngitis. There was no stiffness of the neck. Heart normal, blood pressure 100/66. The lungs disclosed a few scattered mucous rales, and abdomen was negative. Extremities and reflexes were normal except for slight pain in hip joints on flexion of thighs on abdomen. Skin negative. White blood cells 11,050.

The patient was admitted to sick bay as an absolute bed patient under close observation. Symptomatic treatment was instituted. At 10:30 a. m. he had a moderately severe chill, and the occipital headache increased in severity. The temperature rose to 101.6°, pulse 100, and respiration 21. One hour later a slight erythema was noted on his arms and chest. Temperature was 102.6°; pulse, 112; respiration, 22.

He was immediately transferred to the Hankow International Hospital, Hankow, China. While en route he perspired profusely and on arrival 20 minutes later his temperature was 101.6°; pulse, 87; respiration, 20. Spinal puncture revealed clear fluid under normal pressure with five cells per cubic millimeter. The headache disappeared after spinal puncture. There was no evidence of the rash or erythema. The patient minimized his condition and felt very comfortable. The white blood cells was 11,400; myelocytes, 1 percent; bands, 39 percent; segments, 35 percent; lymphs, 14 percent; and large monos, 11 percent. Repeated examination for malarial parasites were negative.

Five o'clock in the afternoon he had a severe chill which was followed by a temperature 105.2°; pulse, 140; respiration, 30. The headache returned and the heretofore mild cough became quite harsh and deep. His breath had a strong fetid odor not noted before. Chest examination elicited marked congestion, and slight dullness over right middle and lower, and left upper lobes. There were loud mucous rales, with fine crepitant rales at the end of inspiration. The expiratory sound was prolonged. Sputum examination revealed many gram positive diplococci in almost pure culture. As there were no typing facilities and after sensitivity test which was negative, 10,000 units of Mulford's polyvalent serum type I and II were given at 8:40 p. m. One hour later he had a terrific chill, pulse 150 and very thready. He had Cheyne-Stokes respiration. One cubic centimeter of adrenalin chloride was given hypodermatically which increased the strength of the pulse and accelerated the rate to 180. Axillary temperature was 108° and respiration 40. The patient became irrational and had to be restrained. One-half grain of morphine sulphate administered. After patient's condition subsided a second spinal puncture revealed clear fluid under moderately increased pressure. There were 11 cells per cubic millimeter and subsequent spinal fluid cultures were negative and Kahn was negative. He perspired most profusely and by midnight his temperature was 100.4°; pulse, 112; respiration, 14. He was also rational. At 2.30 a. m. his temperature was 95°; pulse, 80; respiration, 12. He had no complaints. By 9 a. m. his temperature was 97.6°; pulse, 80; respiration, 20. Examination at this time revealed the patient resting comfortably, the cough was only slight, and most remarkable was the absence of the physical signs of congestion noted the evening before. There were a few scattered mucous rales throughout the chest; white blood cells, 9,800; myelocytes, 1 percent; meta-myelocytes, 1 percent; bands, 42 percent; segments, 33 percent; lymphs, 15 percent; large monos, 8 percent. There was an afternoon rise in temperature to 105°; pulse, 140; respiration, 28. He then perspired profusely necessitating frequent changes of bed clothing during the night. Nine o'clock the following morning, which was the third day of his illness, the temperature was 97.6°; pulse, 80; and respiration, 20. During the day the temperature, pulse, and respiration gradually increased until at 5 p. m. the temperature was 104.8°; pulse, 140; and respiration, 28.

The patient was looking quite toxic by the fourth day. At nine a. m. temperature was 100°; pulse, 96, and respiration, 24. The white blood cells had dropped

sharply to 6,800, with also a marked shift to the left. There was one basophile; myelocytes, 2 percent, meta-myelocytes, 3 percent, bands, 35 percent, segments, 21 percent, lymphs, 23 percent, and large monos, 16 percent. At 7 p. m. 250 cubic centimeters of blood were given by the multiple syringe method, which was followed by a chill with temperature rise to 105.2°, pulse, 104, and respiration, 27. This reaction was followed by a subnormal temperature of 95°, pulse, 60, and respiration, 18. His general condition on the morning of the fifth day showed slight improvement, with an increase in white blood cells to 8,200, basophiles, 1 percent, myelocytes, 1 percent, meta-myelocytes, 1 percent, bands, 32 percent, segments, 35 percent, lymphs, 22 percent, and large monos, 8 percent. The above slight gain shown in blood picture and clinical findings were only transitory, and by the sixth day he was looking quite toxic, with his blood picture showing granulocytic shift to the left. The white blood cells had decreased to 7,800, myelocytes, 1 percent, meta-myelocytes, 1 percent, bands, 35 percent, segments, 30 percent, lymphs, 22 percent, large monos, 11 percent. A second transfusion of 450 cubic centimeters of blood and 100 cubic centimeters of normal saline solution was given. There was no chill following this transfusion and his temperature only rose to 103.6°, pulse, 110, and respiration, 26.

On the following day the patient showed decided improvement, he felt much better and his afternoon temperature was 103.8°. The white blood cells were 9,200; myelocytes, 1 percent; meta-myelocytes, 2 percent; bands, 39 percent; segments, 31 percent; lymphs, 15 percent; large monos, 12 percent. Examination of chest revealed only a few scattered mucous rales. From the seventh to the tenth day of his illness there was a gradual decline in the afternoon rise in temperature, steady marked improvement in his general condition, and no marked change in blood picture until this date. However, on the morning of the tenth day his white blood cells were 13,400; myelocytes, 1 percent; meta-myelocytes, 1 percent; bands, 20 percent; segments, 56 percent; lymphs, 17 percent; large monos, 5 percent. The first X-ray of chest was taken this date as patient's condition was such that it was not advisable to move him to the X-ray room before this time. The lungs were essentially negative except for a moderate increase in infiltration of bronchi extending toward periphery. The heart showed marked dilation of the left ventricle. Next morning the patient complained of a severe pain in right chest. Examination revealed a loud friction rub. The pain was much relieved by immobilization of chest with adhesive plaster. The white blood cells showed an increase to 17,200 with granulocytic shift to the left. On the thirteenth day examination revealed decrease in sound of friction rub, but an area of dullness was noted along costal margin, mid-axillary line. The temperature, pulse, and respiration gradually subsided to normal by the seventeenth day. The pain had disappeared, no dullness could be elicited, and the patient's general condition showed marked improvement. The blood picture was compatible with the clinical course and on this date the white blood cells were 8,600; eosins, 1 percent; meta-myelocytes, 1 percent; bands, 12 percent; segments, 52 percent; lymphs, 27 percent; large monos, 7 percent. The temperature continued to remain normal, no other complication developed, and the patient made an uneventful recovery.

DISCUSSION

The diagnosis in this case was very confusing because the characteristic clinical findings and blood picture were lacking. No diagnosis was made until after sputum examination, the afternoon chill, and rise in temperature to 105°, with the accompanying chest findings

confirmed it. Patient's past history was negative except for malaria and repeated careful examinations were made of the red blood cells to rule out this condition. Repeated blood cultures were negative for pneumococci. Meningitis was ruled out after repeated spinal punctures, spinal fluid examinations, and cultures of spinal fluid, as being a complication. One of the most interesting laboratory findings was the fact that proteus X 2 was positive in 1 to 250 dilution while proteus X 19 was negative. Another examination with new stock of proteus X 2 and ONX 19 were positive 1 to 100 dilution, but proteus X 19 was negative. A local doctor had four cases which agglutinated proteus X 2, 1 to 100, but not proteus X 19 or ONX 19. It was noted that of this group, this case had the highest temperature and perhaps there may be some relation between the temperature and the agglutinating power of his serum to cause precipitation in both proteus X 2 and proteus ONX 19 up to 1 to 100 dilutions.

ATYPICAL MENINGOCOCCIC INFECTION

By W. H. FUNK, Lieutenant Commander, Medical Corps, United States Navy

H. J. A.—C. C. C. white, age 21, entered the United States Naval Hospital, Great Lakes, Ill., on January 9, 1936, for treatment of a left inguinal hernia. On his way to the hospital, he caught cold and his complaint on admission was headache, cold in his head and on his chest. On physical examination at entrance there was noted on his extremities a papular eruption, with breaking down and scab formation at the center and surrounded by a zone of erythema. During his stay at the hospital he had febrile rises to 102 or 103 about every third day, preceded by chilly sensations but not by a definite chill, with a new crop of skin lesions typical of erythema multiforme. Even with febrile accessions his pulse was low, never going over 100.

With the later febrile episodes there was definite joint involvement, redness, tenderness, and pain similar to acute rheumatic fever. Repeated blood cultures were negative. Repeated blood smears were negative for malaria and a therapeutic test was tried with quinine. Because of the joint manifestations, salicylates were given over a long period of time with no improvement.

There were no signs suggesting meningeal involvement until February 27, when a spinal tap was done because of rigidity of the neck and a positive Kernig. No organisms were seen on smear or culture and because of the low chlorides, T. B. meningitis was suspected. On the next tap a Gram negative extra-cellular diplococcus was seen on smear but did not grow on ordinary media. The Abbott laboratories very kindly took some of the fluid and on specially enriched media were able to get a culture which gave an agglutination with antimeningitis serum. Intra-spinal therapy with antimeningitic serum was started on the 8th of March and convalescence was uneventful after 5 days of this therapy.

It is believed that this was a case of atypical meningococcus septicemia giving an irregular temperature chart with erythema multiforme and arthritic manifestations for about 7 weeks and constituted a diagnostic puzzle during this period. After localization in the meninges, the organism could only be grown on specially enriched media, but responded to serum.

TULAREMIA

Report of Two Cases Occurring Among Active Naval Personnel

By Julian Love, Lieutenant, Medical Corps, United States Navy and Alfred W. Eyer, Lieutenant, Medical Corps, United States Navy[1]

Tularemia as a disease entity was established by Francis (1) in 1921. It appeared in the United States Navy Nomenclature of Diseases in the 1923 revision. An excellent discussion of the disease was presented by Simpson (2) in the United States Naval Medical Bulletin in October 1928, and in that same issue four cases were reported by Bunkley and Smith (3). One of these cases occurred in a retired medical officer and two others apparently in nonnaval personnel in the United States Naval Hospital, Washington, D. C. The fourth case was a mild attack in the nephew of the first individual.

It is probable that other cases have occurred among our naval establishments, but to date no report of the disease occurring in the active list of the Navy has been recorded in the "Surgeon General's Annual Report of Disease and Injuries in the Navy for the Calendar Years 1918–35," inclusive. Therefore, the appearance of this entity in two enlisted men on active service is considered sufficiently unusual to warrant its presentation.

Case 1.—R. J., seaman first class, United States Navy. White male, age 21. This sailor reported on April 19, 1936, to the dispensary, United States Naval Air Station, San Diego, Calif., complaining of "painful and tender lumps in the left armpit." He first noted the lump on April 15 accompanied by general malaise, headache, stiffness of neck, chills, fever, sweating, and a moderate degree of weakness. These symptoms became progressively worse and the axillary kernels larger until he reported to the sick bay.

In company with R. N. D. (case 2) and a civilian this man went on a week-end hunting trip near Bakersfield, Calif. They shot five wild rabbits, three of which were skinned by this patient while two were skinned by his companion. They had been warned by local residents to examine rabbits carefully for "boils" or "ulcers", and not to handle or eat animals so afflicted. No lesions were so noted on these rabbits, and the meat was thoroughly cooked.

There was nothing in the family history, habits, or past illnesses which had any bearing on the case. Venereal diseases were denied.

On physical examination a young white male with feverish appearance was noted. His temperature was 99.4° F; pulse, 80; and respiration, 18. Positive findings were injected conjunctivae, three very painful, freely movable pea to marble size lymph nodes in the left axilla, and a slight reddish mark about twice pinhead size on ring finger left hand, dorsal surface at junction of proximal and middle phalanges. There were no other abnormal physical findings, and there were no other enlargements of other lymphatic chains.

Laboratory findings on April 19 were as follows: White blood count, 8,900; differential count, segments, 35 percent; bands, 3; lymphs, 54; monos, 5; and

[1] Our appreciation is expressed for the cooperation and assistance of Lt.-Comdr. F. C. Hill (M. C.), U. S. Navy, and Lt. E. P. Madden (M. C.), U. S. Navy, of the U. S. Naval Hospital, San Diego, Calif., during the hospitalization period of these patients, and, also, to Commander L. L. Adamkiewicz (M. C.) U. S. Navy, for the biopsy and laboratory studies involved.

eosins, 3. The urinalysis showed a faint trace of albumin, a few leucocytes, and and occasional erythrocyte. On April 20 the white blood count was 6,000; differential count, segments, 21 percent; bands, 16; lymphs, 50; monos, 10; eosins, 1; Turck cells, 1; and Rieder's cells, 1. The urinalysis showed a faint trace of albumin, a few granular casts, and a few leucocytes.

On April 19 his temperature rose to 101° F., and pulse to 90, and on April 20 he was transferred to the United States Naval Hospital, San Diego, Calif. On April 21 a small denuded area appeared over the reddened mark previously noted accompanied by swelling and tenderness of the proximal and middle phalanges. From April 23 until May 7 his temperature showed an afternoon rise from 102° to 103° F. with a corresponding increase in pulse. Headache, extreme weakness, some chills and sweats were also noted. One axillary gland continued to enlarge and on May 1 began to soften but was not incised until June 2 when 10 cubic centimeters of pus were evacuated. His temperature began to recede by lysis on May 7 and after May 16 he was afebrile. His weakness persisted even after discharge on July 21, 1936.

The laboratory studies at the naval hospital were as follows:

April 21: Red blood count, 4.46 million; hemoglobin, 85 percent. White blood count, 8,750; segments, 30 percent; bands, 27; juveniles, 5; lymphs, 37; eosins, 3; and monos, 4. Urinalysis showed only a few leucocytes.

April 22: White blood count, 7,450; segments, 35 percent; bands, 38; juveniles, 1; lymphs, 12; eosins, 2; and monos, 12. The Kahn test was negative. The serum showed no agglutination for Pasteurella tularense or Brucella group organisms. The serum was submitted to the Scripps Metabolic Institute and California State Public Health in addition to the local hospital laboratory.

May 4: Cultures of ulcer on finger were positive for staphylococci.

May 5: A guinea pig was innoculated with serum aspirated from the ulcer on the finger; 1 cubic centimeter of the suspension, intraperitoneally, and 0.5 cubic centimeter, subcutaneously. On May 11 the pig died. Autopsy report: "The pig appeared to be losing weight. The liver revealed numerous nodules and discolored ulcerated areas. The lungs appeared congested. Cultures made from liver and lungs were negative for Pasteurella tularense."

June 2: Serum agglutination positive for Pasteurella tularense in dilution 1 to 640. Highest agglutination with Brucella group organisms, 1 to 80; positive for tularemia.

Bunnell test was negative. Guinea pig innoculated with pus from axillary abscess. One cubic centimeter was given intraperitoneally and 0.5 cubic centimeter subcutaneously.

June 9: Smear from axillary abscess was negative. Culture of the same material revealed no growth.

June 23: The guinea pig was killed. Autopsy report: "The pig was apparently healthy and fat. It shows no apparent pathology. The internal organs were of normal appearance. No nodules were present. The lymph glands were normal."

On July 21 the patient was returned to duty with scanty drainage left axilla. He complained of slight asthenia.

Case 2.—R. N. D., seaman, first class, United States Navy. White male, age 18. This sailor reported to the dispensary on April 19 accompanying R. J. (case 1). His complaints were similar except that his "lumps" and tenderness were in the right axilla. Physical findings were essentially negative except for enlarged lymph nodes about the size of a large marble in the right axilla. No external abrasions were noted on right hand, wrist, or forearm. His white blood count was 7,400; the differential count, segments, 45 percent; bands, 4; lymphs, 37; monos, 8; eosins, 5; and basos, 1. The urinalysis showed only a

few leucocytes and squamous epithelial cells. By evening his temperature rose to 101.6° F. accompanied by sweating and on April 20 he was transferred to the United States Naval Hospital, San Diego, Calif.

From April 21 until May 1 his temperature rose daily to 103° F. His main complaint was weakness with chills and sweats. From May 1 until May 16 his temperature declined to normal, and he remained afebrile until July 21, the date of discharge. The right axillary lymph node increased in size and induration, and became immovable and quite tender. On May 7 it began to soften, and on May 22 10 cubic centimeters of creamy pus were aspirated from the abscess. On June 22 the fluctuant area was widely incised for drainage. There was gradual improvement until he was returned to duty.

Laboratory studies while in the hospital were as follows:

April 21: Red blood count, 4.46 million; hemoglobin 85 percent, white blood count, 7,650; segments, 32 percent; bands 32 percent; juveniles, 2 percent; lymphs, 24 percent; eosins, 6 percent; and monos, 4 percent.

The urinalysis revealed some mucus and leucocytes.

April 22: White blood count, 6,050; segments, 50 percent; bands, 15 percent; lymphs, 29 percent; and monos, 6 percent. The Kahn was negative.

May 22: No agglutination for Pasteurella tularense or Brucella group organisms was noted. Serum reported by the three laboratories was negative. A guinea pig was innoculated with pus from the right axilla, 1 cubic centimeter intraperitoneally, and 0.5 cubic centimeter subcutaneously.

May 29: The Bunnell test was negative.

June 2: Serum agglutination for Pasteurella tularense antigen was positive in dilution of 1 to 2560. Highest dilution for Brucella group organisms was 1 to 80.

June 23: The guinea pig was killed. Autopsy report: "The pig was normal and healthy in appearance. The internal organs were surrounded by fat. No nodules or discoloration were present. The lymph nodes were normal. The pus inoculated May 22 was apparently sterile." The patient returned to duty well July 21 1936.

DISCUSSION

Tularemia may affect an individual in one of four ways; namely, ulceroglandular, oculoglandular, glandular, or typhoidal. Case 1 would be classified as ulceroglandular though actually it appeared to be "glandulo-ulceral." Case 2 represents the rarest clinical variety which is the glandular. Case 1 is a right-handed individual and held the rabbit in his left hand while skinning with his right, while case 2 is left-handed and so held the rabbit with his right hand. This may account for the presence of the adenitis in the left axilla of the former, and in the right axilla of the latter.

The civilian who accompanied the sailors on the hunting trip must have handled the rabbits, too, since he was affected with the ulceroglandular type of the disease. He was treated by a physician in Bakersfield who incised the axillary abscess while under the impression it was one of nonspecific suppuration. It was not until the cases reported above wrote the true diagnosis to their civilian friend that he received specific therapy which consisted of injections of Foshay's antiserum. These injections were reported to have been ineffective

as they were probably given too late. Foshay (4) states that for the serum to be efficacious it must be used before the twelfth day of the disease.

The above cases illustrate very clearly that the organisms can penetrate the unbroken skin, the incubation period of about 4 days, and the delay in formation of specific antibodies (agglutinins) until after the tenth day of the disease. In these cases positive agglutinations were not obtained until after the third week of the disease.

The diagnosis was readily made in these two cases, because the medical officer who first saw the patients had the disease in mind and questioned them about contact with rabbits. A suspicion of this disease should always be aroused by the presence of unexplained axillary or femoral adenitis.

Bakersfield, Calif., is in Kern county, 350 miles from San Diego, and only 25 miles from Tulare County where Chapin and McCoy first isolated Pasteurella tularense in 1912 and so named it for the county in which it was discovered.

CONCLUSION

1. Two cases of tularemia occurring in active Naval personnel are reported. These apparently are the first to appear among the active list of the Navy.

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NEUTROPENIA FOLLOWING THE ADMINISTRATION OF NEOARSPHENAMINE

By Albert R. Behnke, Lieutenant, Medical Corps, United States Navy.

This clinical report describes an uncomplicated neutropenia indicative either of an early involvement of the leucopoietic function of the bone marrow or of a destruction of granulocytes in the peripheral circulation following neosalvarsan administration. While the blood platelets, and on one occasion the lymphocytes, were decreased in number, the primary involvement was characterized by a decrease in granulocytes.

The interesting features of this report are the specific neutropenia with little involvement of the red blood cells, the freedom of the

patient from upper respiratory tract infection, the absence of other serious manifestations of neoarsphenamine toxicity, including purpura, jaundice, and skin ractions, and the rapid, spontaneous recovery.

From a partial survey of medical literature it is evident that the arsphenamines may depress the function of any or all of the cells formed by the bone marrow. This comparatively rare reaction complicating the administration of the arsphenamines is probably caused by the action of the double benzol ring present in these compounds since inorganic arsenic does not depress bone marrow function. Roberts (1) quotes Farley (2) who considers it likely that, in certain persons, there is a disintegration, in vivo, of the arsphenamine molecule setting free the benzol radicle so that a benzol-like action takes place.

The action of neoarsphenamine on the peripheral cells and blood platelets rather than on the bone marrow should also be considered in view of the rapid and spontaneous recovery (3).

The excellent papers and case reports on blood dyscrasias following the use of arsphenamine compounds appearing in previous issues of the Naval Medical Bulletin render further discussion unnecessary.

CASE HISTORY

D. W., electrician's mate, first class, age 37, was first admitted to the submarine base dispensary, Pearl Harbor, on December 11, 1935, with multiple ulcers on the prepuce; dark field examination was positive for treponema, the blood Kahn was negative. Nine hours after the first injection of neosalvarsan (0.3 gram) and thiobismol (0.2 gram) the patient developed fever and malaise. White blood cells 6,050 with neutrophils 56 percent; lymphocytes 42 percent; and eosinophils 2 percent. Recovery was rapid and uneventful. The following antiluetic treatment was then administered over a period of a year: 25 injections of neoarsphenamine (14.1 grams) and 29 injections of bismuth salicylate (4.4 grams).

On December 26, 1936, the patient complained of intermittent nausea and pain in the upper abdomen of about 3 weeks' duration. All treatment was discontinued until February 20, 1937, when the patient felt well and appeared to be in good condition. From February 20, 1937, to March 13, 1937, four injections of iodobismitol, total 8 cubic centimeters, were given. Following these injections the patient complained of soreness over the hypothenar and metacarpal areas of the left hand. Iodobismitol was discontinued and neoarsphenamine was administered in the following manner: February 20, 0.3 gram; March 27, 0.6 gram (patient was nauseated following this injection); April 3, 0.15 gram; April 10, 0.3 gram.

Present illness.—On April 13, 1937, the patient complained of chilliness, headache, abdominal soreness, and malaise. He stated that the chills began on the previous day or about 48 hours after the last injection of neosalvarsan. The physical examination was negative except for a fever of 100.4° F. The symptoms rapidly subsided with bed rest and a high caloric diet. On April 17 the patient was up and about, and in good condition except for a slight evening rise in temperature. Urine analyses were repeatedly negative, icterus index was 6, and the

blood sedimentation time was within normal limits. The blood picture was as follows:

	Hb.	Red blood cells	Platelets	White blood cells	Seg.	Band	Mono.	Lymphs.
April 14	85	4, 240, 000		3, 500	980	140	280	2, 100
April 15			84, 800	3, 650	1, 022	146	401	2, 080
April 16				2, 200	1, 012	132	44	990
April 17				3, 950	1, 619	158	79	2, 054
April 19	90	4, 640, 000	279, 000	4, 650	2, 511	186	186	1, 767
April 22	95	4, 980, 000	179, 000	4, 750	2, 375	142	190	1, 995
April 23		4, 900, 000	215, 000	5, 300	3, 233	212	106	1, 590
May 14	95	5, 030, 000	285, 040	5, 400	2, 430	324	216	2, 376

On April 24, 1937, the cerebrospinal fluid was negative for syphilitic involvement, and 2 days later the patient was discharged to duty in good condition with the recommendation that arsenical therapy be permanently discontinued.

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(4) Mink, O. J., and Campbell, H. D. Toxic Effects of Arsenical Compounds Employed in the Treatment of Syphilis in the United States Navy, 1931. U. S. Nav. Med. Bull. 31: 177, 1933; Toxic Effects of Arsenical Compounds Employed in the Treatment of Disease in the U. S. Navy, 1932. U. S. Nav. Med. Bull. 31: 383, 1933.

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NAVAL RESERVE

PROMOTIONS, THIRD QUARTER, 1937

James Dominic Viecelli, 450 Sutter Street, San Francisco, Calif., promoted to lieutenant commander, MC–V (G), U. S. N. R., September 27, 1937.

Edward Lee Alexander, Medical Arts Building, Newport News, Va., promoted to lieutenant, MC–F, U. S. N. R., September 7, 1937.

Herman Maurice Garnett, 3019 Thirty-fifth Street, Long Island City, N. Y., promoted to lieutenant, MC–F, U. S. N. R., September 14, 1937.

Albert Hanly Held, 415 Jackson Street, Huntingburg, Ind., promoted to lieutenant, MC–V (G), U. S. N. R., September 27, 1937.

John Claude Hull, 4011 South Presa Street, San Antonio. Tex., promoted to lieutenant, MC–V (G), U. S. N. R., September 30, 1937.

William Chunn Parsons, 420 Woodward Building, Birmingham, Ala., promoted to lieutenant, MC–F, U. S. N. R., September 24, 1937.

Keitt Hane Smith, 206 East North Street, Greenville, S. C., promoted to lieutenant, MC–F, U. S. N. R., July 30, 1937.

RESIGNATIONS, THIRD QUARTER, 1937

Lawrence P. Engel, 1228 Professional Building, Kansas City, Mo., lieutenant, MC–V (S), U. S. N. R., resignation accepted August 19, 1937.

Hal Elson Freeman, the University Hospitals (Lakeside), Cleveland, Ohio, lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted August 19, 1937.

Walter E. Hennerich, 4030 Chouteau Avenue, St. Louis, Mo., lieutenant commander, MC–F, U. S. N. R., resignation accepted August 2, 1937.

Willard H. Kinney, 315 South Seventeenth Street, Philadelphia, Pa., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted August 26, 1937.

Charles F. McCaffrey, 44 Summer Street, Somerville, Mass., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted August 29, 1937, in order that he might accept appointment as lieutenant, junior grade, Medical Corps, United States Navy, effective August 30, 1937.

John S. McKee, c/o Western State Hospital, Morgantown, N. C., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted September 15, 1937.

Thomas T. Sheppard, 530–532 Medical Arts Building, 3700 Fifth Avenue, Pittsburgh, Pa., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted September 22, 1937.

Wallace B. Smith, 490 Post Street, San Francisco, Calif., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted August 2, 1937.

HONORABLE DISCHARGES, THIRD QUARTER, 1937

Lloyd W. Bishop, 698 Congress Street, Portland, Maine, lieutenant, junior grade, MC–V (G), U. S. N. R., honorably discharged August 19, 1937.

Henry A. Cromwell, 30 East Seventy-sixth Street, New York City, N. Y., lieutenant, junior grade, MC–V (G), U. S. N. R., honorably discharged August 26, 1937.

DEATHS, THIRD QUARTER, 1937

Guy D. Conover, 225 Santa Monica Boulevard, Santa Monica, Calif., lieutenant, MC–V (S), U. S. N. R., died May 1, 1937.

THE NINTH ANNUAL MEDICO-MILITARY SYMPOSIUM

By Lincoln Humphreys, Lieutenant Commander, Medical Corps, United States Navy

The 1937 course of military, naval, and scientific training conducted at the Mayo Foundation, Rochester, Minn., for medical and dental officers of the Army and Navy Reserve, occupied the period from October 3 to 17, 1937. This, the ninth annual training course, the fifth in which the Navy has participated, was attended by medical and dental officers of the Naval Reserve from widely distant portions of the United States, including representatives from California, the District of Columbia, Illinois, Indiana, Iowa, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, Virginia, and Wisconsin. The Navy and Navy Reserve attendance was 42 but this figure does not include the 15 members of the Naval Reserve specialists units normally attached to the Mayo Foundation on the staff of that institution, who attended and contributed to the success of the meeting by scientific papers and clinical demonstrations.

Distinguished guest speakers included the Surgeon General of the Navy; Maj. Gen. Charles R. Reynolds, Medical Corps, United States Army; Surgeon General of the Army; Maj. Gen. Stanley H. Ford, United States Army; the Commanding General of the Seventh Corps Area, with headquarters at Omaha, Nebr.; and Dr. S. L. Christian, Assistant Surgeon General of the United States Public Health Service.

Instructors for the Army were Col. Kent Nelson, Medical Corps, United States Army, surgeon Seventh Corps Area, and Lt. Col. John R. Hall, Medical Corps, United States Army, Medical Inspector, Seventh Corps Area. Instructors for the Navy were Capt. Ausey H. Robnett, Medical Corps, United States Navy, district medical officer, ninth naval district, and the author who also collaborated on program preparation with the Seventh Corps Area surgeon and medical inspector, and represented the Bureau of Medicine and Surgery in allocation of Navy medical participation. The Navy Department was most generous this year in ordering medical officers of high rank to represent the Navy Medical Department.

As during previous years, Lt. Fred L. Smith, Medical Reserve Corps, United States Army, a member of the Mayo Foundation staff, served as plans and training officer. Through the collaboration of

this efficient officer with the Army and Navy representatives a well balanced program was prepared and published prior to the beginning of the course. This course like those previously reported, was conducted as a joint training course for the medical and dental officers of the Army and Navy Reserve, with the surgeon of the Seventh Corps Area as the administrative head, and with whom the author worked as the Navy representative.

A new plan was effected this year in arranging the morning session. A reservist could witness a surgical operation, then proceed to Plummer Hall and receive instruction in the allied specialties by leading members of the Mayo clinic staff. Naval reservists who lectured at these morning sessions were: Lt. Comdr. W. McK. Craig, Lt. Comdr. C. H. Watkins, and Lt. Comdr. H. M. Weber, all members of the staff of the Mayo Foundation, and Lt. Comdrs. E. H. Bruening and Milton J. Waas.

The Navy received a generous allocation of instruction periods on the program. A well balanced schedule of instruction was presented and included a number of outstanding Navy speakers. The papers presented by these naval participants on the program were well received. The civilian physicians in attendance were enthusiastic over the medico-military discussions and many questions resulted from the lectures on naval subjects. There were also inquiries made about steps necessary to join the Navy Reserve, Medical Specialists units. This, it is believed emphasizes the importance of this type of joint Army and Navy training course, given in conjunction with clinical conferences at well established medical institutions. Through cooperation of the civilian medical institutions reserve medical and dental officers are enabled to attend the medical, surgical and other special clinics and to avail themselves of the advantages of scientific discussions by leading civilian medical specialists. A summary of medical officers of the Navy and Navy Reserve who presented papers during the afternoon and evening sessions is as follows:

Rear Admiral P. S. Rossiter, Surgeon General of the Navy, and Chief of the Bureau of Medicine and Surgery, Subject: Logistics, Interrelation Aboard Ship and Tactics.

Capt. A. H. Robnett, district medical officer, ninth naval district. Subject: Some Problems of the Naval Medical Officer.

Capt. G. W. Calver, Physician to Congress. Subject: Administration of a Naval Hospital. Captain Calver also showed moving pictures of Spain and Shanghai before and after bombing which made an indelible impression upon all those present.

Capt. E. W. Brown, Naval Medical center, Washington, D. C. Subject: Naval Medical Aspects of Chemical Warfare.

Commander Joel J. White, Chief of the Medical Service, Naval Hospital, Philadelphia. Subject: Present Status of Artificial Fever Therapy in Medico-Military practice.

Commander Kemp C. Christian, District Headquarters, Great Lakes, Illinois. Subject: Navigation.

Lt. Comdr. Lincoln Humphreys, Assistant Instructor. Subject: The United States Fleet.

Lt. Cmdr. W. McK. Craig, Mayo Foundation Staff. Subject: Relief of Intractable Pain.

Lt. Cmdr. Frederick A. Jostes, President of the St. Louis Clinical Society. Subject: Backache and its Treatment.

Lt. Cmdr. U. S. Widman, New Albany, Ind. Subject: European Cruise of the U. S. S. *Charleston.*

Lt. Cmdr. E. H. Bruening, Professor of Dental Anatomy, Creighton Dental School, Omaha, Nebr. Subject: Governmental Public Health Relations.

Lt. R. B. Phillips, Fellow of the Mayo Foundation. Subject: Medical Advertising of the Civil War Period.

Lt. R. B. Phillips, MC–V (S) United States Naval Reserve, a fellow of the Mayo Foundation, served in the capacity of adjutant and aided greatly in securing pictoral and editorial publicity for the meeting. He arranged a luncheon at the Hotel Arthur at which the Naval Reservists honored the Surgeon General of the Navy, and attended not only by the Naval Reservists from out of the city but also by the majority of the members of the two specialists units of the Mayo Foundation. This was quite an accomplishment considering that the latter are busy specialists and their spare time is greatly limited. At this time the Reservists were given the opportunity to meet Rear Admiral Rossiter, and to hear from him his personal and official interest in these training courses. The Admiral expressed hearty approval of the course as presented at Rochester, and it was with regret that he was unable to remain, due to the fact that he had to proceed to Los Angeles, Calif., to deliver the presidential address before the Association of Military Surgeons. His tribute of gratitude to the Mayo Foundation for extending the clinic facilities so generously was the general sentiment of those in attendance.

WILLIAM KNICKERBOCKER VAN REYPEN.
Surgeon General, United States Navy, 1897-1902.

NOTES AND COMMENTS

WILLIAM KNICKERBOCKER VAN REYPEN

By LOUIS H. RODDIS, Commander, Medical Corps, United States Navy

The twelfth Surgeon General, U. S. Navy, and the sixteenth Chief of the Bureau of Medicine and Surgery, was born in New Jersey in 1840, and was appointed from that State as an assistant surgeon on Christmas Day, December 25, 1861. After a short period of duty at the naval hospital, New York, he served on the steam frigate *St. Lawrence* in the East Gulf Blockading Squadron and so saw active war service at sea in the blockade of the southern ports. He was promoted passed assistant surgeon in May 1865, and surgeon in May 1868. His service included duty at the naval hospital, Chelsea, Mass., Norfolk, Va., Annapolis, Md., and New York. His sea duty included both the European Squadron and the Asiatic Station. He was promoted to medical inspector in August 1887, and medical director just 6 years later, in August 1893. He was appointed Surgeon General by President McKinley on October 23, 1897, to succeed Surgeon General Newton L. Bates, who died in office after serving but 18 days. Van Reypen served until January 25, 1902, and was thus Surgeon General during the Spanish-American War and under two Presidents, McKinley and Theodore Roosevelt. He was an excellent economist. His regime was marked by many important measures affecting the Medical Department. A hospital ship, a separate Hospital Corps, and increased rank for medical officers had been strongly urged by Surgeon General Tryon, and Congress now passed legislation providing for all three of these measures. The steamer *Creole* of the Cromwell line was purchased and named the U. S. S. *Solace*. This vessel was selected, purchased, and fitted out for service as a hospital at the beginning of the Spanish-American War in just 16 days. It was the first of our naval vessels to fly the Red Cross flag. It was of the greatest service to the fleet in Cuban waters, and remained in active commission until 1920.

In 1899 the Surgeon General was given the rank of rear admiral, though the pay and allowances were still those of a commodore. The following naval hospitals were commissioned during Van Reypen's term of office: Naval hospital, Newport, 1897; Sitka, Alaska, 1898; Port Royal, S. C., 1898; Cavite, P. I., 1898.

After retirement, Admiral Van Reypen lived in Washington, where he died in 1920.

THE FLEET HOSPITAL SHIP

The characteristics of a hospital ship should be based upon its objective. No one type of craft would be equally suitable to function as a fleet hospital ship, hospital transport, hospital ship for advanced base, or rescue ship. Furthermore the problem arises of meeting the peak load of wartime demand without creating a top-heavy peacetime organization.

Of these various types of hospital ships, Johnson[1] discusses in detail the fleet hospital ship. This author has written extensively on subjects of interest to the naval medical officer and this article summarizes his recent and mature experience on a fleet hospital ship. In his opinion this type of vessel should be about 10,000 tons in size, have a speed somewhat in excess of the train, be designed for fleet hospital-ship duty, that is, accommodate patients satisfactorily while conforming to fleet operating conditions such as darken ship.

This vessel should operate with the fleet in peace and in war, providing hospital and specialty service. The author comments at length on the extent to which this vessel should conform with Hague Convention provisions to gain immunity to hostile attack. Based both on its intimate function with the fleet and the World War experience, particularly of the British, he definitely recommends that this type vessel waive its immunity and accept the hazards common to the fleet. Other type hospital ships should continue to conform to Hague Convention provisions.

BLUNDERS OF PLAIN MUSCLE

"The frustrated subconscious uses the autonomic system as its secret avenger, and spasm is commonly its sword." Thus does Eve[2] call attention to the vegetative nervous system which induces a smooth muscle hypertonus, particularly during anxiety state in the sensitive intellectual, ambitious, and idealistic temperament. The maiden's blush and the diarrhoea of the nervous examinee may result from different stimuli but they are actuated by the same mechanism. This muscle spasm may be more accurately described as an inability to relax with sympathetic tonus dominating the antagonistic vagus.

A wide variety of intestinal, vascular, and genito-urinary symptoms result. No age is immune. The newborn infant may have pylorospasm. In males it is always associated with phimosis. It may accompany the anxiety of a nervous mother. In adults the mani-

[1] Johnson, L. W., Captain (M. C.), U. S. Navy. The Fleet Hospital Ship, U. S. Naval Institute Proceedings, 63: 1225–1235, 1937.

[2] Eve, Frank C. Blunders of Plain Muscle Due to Allergy or Anxiety States, Lancet 233: 660, 1937.

festations are many and usually multiple. If there is hunger pain due to pylorospasm, look for palpable, cordlike tender colon, urinary frequency, cold extremities, and spastic dysmenorrhea. The cause is probably exhaustion, chill, worrry, or alcohol. If coronary spasm is suspected, look for intermittent claudication and "dead fingers." Raynaud's disease and probably migraine result from angiospasm. If migraine occurs in early life look for intestinal or cardiovascular spasticity in later life. Asthma is one of the conspicuous blunders.

Allergy must be considered as a possible factor in causation of smooth muscle spasticity. Allergy may be considered as a stormy immune reaction in a subject of sensitive temperament to various chemical stimuli so great that marked clinical symptoms result. It is associated with histamine production and is relieved by adrenaline, in contrast with anxiety states which are associated with production of choline and relieved by atropine or ergotamine.

The author postulates the suggestion that individuals of sensitive temperament respond most successfully to the demands of civilization and that the price of this sensitivity is neurosis and allergy.

TREATMENT OF SURGICAL SHOCK WITH NEOSYNEPHRIN

Loss of vascular tone with consequent vasodilatation is one of the more or less conspicuous etiological factors causing the hypotension of surgical shock. Its prominence may be roughly estimated as proportional to the nervous trauma experienced. Rational treatment of surgical shock would, therefore, indicate the use of vasoconstrictor drugs for the vasogenic phase of hypotension. Adrenaline, epinephrine, and ephedrine are effective and have been employed to increase vascular tone. Unfortunately each has objectionable effects.

In the search for a more effective drug Johnson [3] has used neosynephrin hydrochloride for shock due to trauma and hemorrhage. This drug is very closely related to epinephrine hydrochloride. It is preferable to the other vasoconstrictors in that (1) its action is more prolonged, lasting 1 to 2 hours, (2) it has no ill effect on cardiac rhythm, (3) in shock cases the heart rate is not affected—in the normal individual it is slowed, (4) it does not cause nervousness or palpitation, and (5) it has a much greater margin of safety. It is employed in a dosage of 1 cubic centimeter of a 10-percent solution subcutaneously, from 1 to 23 doses being administered to patients in the author's series.

It was employed in surgical, traumatic, and spinal anesthesia cases. In the latter group it was used both to restore normal blood pressure and as a preliminary prophylactic measure to prevent the usual

[3] Carl A. Johnson. Surgery, Gynecology and Obstetrics, 65: 458–463, 1937.

resultant hypotension. It is interesting to note that the drug was useless in combating the hypotension resulting from foreign protein anaphylactic shock.

There is general agreement that shock is due to loss of effective blood volume. Opposed theories attribute this loss to stagnation in the vascular system and to actual loss from the vascular system. Action of this drug would tend to support the stagnation theory in Johnson's opinion.

THE COMMON COLD

The common cold continues as a major cause of physical disability. At best it is an embarrassing condition and not infrequently it is the forerunner of complications that endanger life. Evidence is becoming more conclusive that this infection is due to a filterable virus and that this virus activates pathogens present in the upper respiratory tract. It has been the subject of extensive investigation and the resultant findings are still far from consistent and conclusive. There is likewise no unanimity of opinion as to proper treatment. Medication is largely empirical, if taken at all, and much of this is self-supervised. A well-balanced diet with liberal vitamin content and hygienic mode of living may be safely recommended. Beyond this, treatment may be regarded as conjectural and controversial. Unfortunately, whether treated or untreated, the victim is usually ambulant and his activity constitutes a menace to his health and a public-health hazard to his associates.

This condition is usually ushered in by a feeling of chilliness, sneezing, and a dryness in the nasopharynx. In the normal individual exposed to cold there is a temporary blanching of the nasal mucosa which is transient. In the susceptible individual, made susceptible presumably by presence of a filtrable virus to which for various reasons the individual has a low grade of immunity, this blanching persists for an extended period. As a result there is a loss of mucous secretion with a sense of dryness and a loss of ciliary action with a corresponding stagnation in the normal flow of nasopharyngeal secretion. It is a fair presumption that this stagnation of nasopharyngeal and sinus drainage is at least a factor in promoting the propagation of nasopharyngeal pathogens. The normal sequence of events is for the ischemic state to progress to an hyperemia with more or less nasal and sinus obstruction.

Rational treatment would suggest combating the ischemia and ciliary paralysis in the early stage, and combating the hyperemia with its associated obstruction and hypersecretion later. Rest in bed and heat to the lower extremities are particularly effective for the initial eschemia, and should be continued until the patient responds normally to chilling effect.

There seems to be little rhyme or reason for the local medication applied in either stage. It varies from heroic measures to no treatment due to the patient's indifference or fatalistic resignation. Various investigators have reported on the action of normal cilla, and on ciliary response to various drugs. Water and water solutions such as the silver proteinates inhibit ciliary activity. Oil and the various oily preparations prevent ciliary action mechanically. Silver nitrate destroys the cilla. Atropine, adrenalin, and cocaine paralyze ciliary action. The aromatic oils, particularly thymol are depressing. Methiolate and mercurochrome are also depressant. Codeine, morphine, and the barbiturates cause little if any depression of ciliary action. Normal saline has a favorable effect on ciliary action, and used alone can be recommended and may be combined with about 1 percent ephedrine for local use. The saline solution is best applied with a medicine dropper in head-low posture.

Vaccines of various types and administered by various routes—subcutaneous, oral, and nasal—have had advocates for years, particularly among grateful patients. The use of vaccines has some scientific justification on the basis that they have a favorable effect on control of the pathogens activated by the virus. This action helps explain the results noted in their use. The estimate equation of prophylactic value of vaccines includes variables from allergy to zeal. Obviously in such a poorly controlled group much dependence must be placed on the patient's subjective reaction and reports whether favorable or unfavorable should be evaluated accordingly.

Bristol,[4] health director for the American Telephone & Telegraph Co., of New York, reports interesting studies on an industrial group to whom vaccine was made available. He states that an industrial group can be roughly classed as follows: (1) The cold-proof who seem to never have colds, (2) the person of average susceptibility having one or two minor colds a year, and (3) the cold-prone who have several colds a year often with complications and disability.

This third class constitutes about 25 percent of the entire group. It serves as a year-round reservoir for the common cold and presents a public-health problem both from the standpoint of absenteeism of the individual and as a source of infection for associates. The treatment results reported by Bristol were not limited to this class of patient. However, it is a fair presumption that vaccinated individuals from this group were materially in excess of 25 percent.

Bristol summarizes the results obtained in six different companies. The material used consisted of commercial standard stock vaccine or sero-bacterins administered by local practicing physicians to employees requesting treatment. Each company reported treatment

[4] Bristol, Leverett D. Vaccines Against the Common Cold, American Jour. of Public Health, and the Nation's Health, 27: 987–990, 1937.

of more than 1,000 employees over a period of several years. One company reported treatment of about 13,000 over a period of 17 years.

All reports were favorable, none were enthusiastic. There was little evidence that vaccination had reduced the incidence of common colds. There was an apparent reduction in the severity, duration, and complications of acute respiratory diseases in the treated.

Recently an oral vaccine has been introduced in a naval dispensary service. As noted above, there is difficulty in obtaining an accurate estimate of prophylactic value from the patients' statements. However, the popularity of this oral vaccine in this dispensary would indicate that it has sufficient merit to continue its use on trial.

CANCER

The physician and layman are both becoming more cancer conscious. This tendency has already improved the prognostic outlook for the patient. Recent developments have been particularly encouraging. The United States Public Health Service has obtained funds and site for a Cancer Institute at Washington, which will soon be functioning. This will permit a long awaited concerted attack on the vexing problem of malignancy.

Past progress has largely been the product of individual effort. Much has been accomplished with a surprisingly meager outlay. A patiently scientific, coordinated attack, comparable to that used so effectively in industrial research may now be anticipated. However, investigation has already proven the problem to be so intricate that a conservative attitude should be assumed on prospect of solution of the etiology and treatment of malignancy at an early date.

Cancer is not a major problem in the active service from the standpoint of sick days or retirements and surveys involved. However, it is of sufficient importance that cancer clinics have been established on each coast.

The October issue of Annals of Surgery presents an excellent symposium on cancer. Various authorities comment on the latest developments in the etiology and treatment of malignancy. It can be highly recommended to those interested in cancer.

SKIN IRRITATION AND CANCER IN THE UNITED STATES NAVY [5]

This is a statistical review of morbidity and mortality statistics of the United States Navy covering the 8-year period from 1929 to 1936. It involves 875,000 person years of active service and 469 cases of cancer.

It is known that in rural districts epitheliomata of the skin and lip are more frequent than in the cities. Animal experiments have dem-

[5] Sigismund Peller and Charles S. Stephenson. American Journal of The Medical Sciences, 194: 326-333, 1937.

onstrated that ultraviolet rays play a part in the genesis of skin cancer. Therefore, the present study was undertaken to ascertain, first, whether a group of adults between 16 and 45 or 50 years of age, exposed intensively to open air, to sun rays, and to salt water suffer from skin and lip cancer more than the average; second, whether or not this group shows the same probability of dying from cancer of the inner organs as does the general population; third, whether or not young men cured of a skin or lip cancer are later as much disposed to cancer of the internal organs and of the surface as men of the same age group.

In this review it was found that the incidence of cancer of the skin and lips was eight times and the mortality was three times the normal expectancy of the average population of like age group, with melanoma predominating. In answer to the second question it was found that morbidity and mortality from all other cancers was greatly diminished in this group. In answer to the third question, the investigators found three cases of fatal cancer of internal organs in cases cured of skin epithelioma. One had squamous cell carcinoma of the nasal septum and the second died of carcinoma of the aesophagus. Their third case was a carcinoma of lung which they regard as probably being synchronous with the skin lesion rather than metachronous. The three cases were over 50 years old. Also they noted that of all the cases of cancer of the internal organs in patients from 30 to 50 years of age none gave a previous history of cured skin or lip cancer.

These statistics would imply that these skin lesions confer a certain protection against the more malignant cancer of internal organs in later years. The authors propose that this phase of the investigation needs study on a larger scale.

SYPHILIS PROPHYLAXIS

Syphilis has become a popular issue and it behoves the profession to keep well-grounded on scientific fact in educating the public on this dread disease.

The initial lesion is of prime importance if subsequent sequellae and prolonged treatment would be avoided. Much of the knowledge of the initial lesion has been based on the experimental work of Metchnikoff and Kolle. On the basis of this work the former developed a very effective calomel ointment prophylaxis. Kolle, later, demonstrated the rather spectacular rapidity with which the syphilis spirochaeta penetrates the tissues of the experimental animal where an abrasion is present. He applied the virus to a scarified area and recovered the organisms 5 minutes later from the lymphatic glands 8 centimeters away.

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On the basis of several years experimental work Surgeon J. A. Mahoney, United States Public Health Service, reports on tissue invasion by the spirochaeta. They deposited the syphilis organism upon the intact genatile mucosa of the male rabbit. One hour later the organisms were found upon the surface of the mucous membrane and occupying a more or less protected position in the crypts and folds of the integument. After 2 hours, there was evidence of penetration of the deeper tissues. At the end of 3 hours the organisms had penetrated to a depth which would have rendered them immune to the direct influence of any agent applied to the surface.

In contrast with this penetration of uninjured genatile mucous membrane this investigator reports that they were never able to demonstrate penetration of stratified squamous epithelium by the spirochaeta.

Data on prophylaxis are consistant with these findings. This investigator demonstrated that mechanical cleansing with soap and water gave very effective protection for exposures not exceeding 1½ hours and beyond 2 hours was completely ineffective. After 3 hours use of disinfecting agents of more drastic type such as tincture of iodine were relatively ineffective. Interesting features of calomel ointment are reported by this investigator. He found that the prophylactic effect of this chemical was dependent upon applying it as an inunction. When applied to the genatile mucosa without rubbing it was not protective. When thoroughly rubbed in it gave a high percentage of protection, and was even protective when the virus was not applied to the treated area. The inference of this work is that the efficacy of calomel is probably due to its systemic spirochaeticidal action.

It would seem from this experimental work that our present system of prophylaxis, consisting of soap and water wash followed by calomel inunction has a sound scientific background. To be effective this method demands prompt application, preferably within the first hour after initial exposure, and thorough inunction of the calomel ointment.

ARTICLES ON PROFESSIONAL SUBJECTS

Recently several articles on professional subjects have been submitted to the Navy Department for permission for publication. Article 113 ofNavy Regulations and General Order No. 9 do not require this permission.

Authors are required by these references to publish no secret or confidential information or information that would support a claim against the Government. These regulations carry two additional specific provisions. Any published article represents the personal views of the writer and not those of the Navy Department and shall so state. Second, when the article is accepted for publication a copy shall be forwarded to the Navy Department for information and file. To this should be added the advice to avoid domestic and foreign politics, and comment that is derogatory to the service.

A naval officer on his own personal responsibility is permitted to present his article to a publisher for publication. The Navy Department does not exercise censorship on such material; it, on request, merely advises as to propriety of publication.

When under the provisions of reference regulations the author has doubts as to the advisability of dissemination of information to the general public of any matter through the medium of books, magazines, press, or radio, he may submit his article to the Navy Department. This must be done prior to submission to the publisher and the accompanying letter of transmittal shall designate the specific passages about which doubt exists and the reasons for said doubt. The Navy Department will then inform the author as to the propriety of publishing the designated passages.

ARTICLES OF SPECIAL MERIT, 1937

It has become an established practice for the Surgeon General to present letters of appreciation to authors who have contributed articles of outstanding merit to the NAVAL MEDICAL BULLETIN.

The Surgeon General takes this opportunity to express to all contributors his satisfaction with the excellence of their articles and his appreciation of their support of the Bureau's publication.

For the calendar year 1937 the following authors have received letters of appreciation.

Lt. Albert R. Behnke, (M. C.), U. S. N. The Application of Measurements of Nitrogen Elimination to the Problem of Decompressing Divers. April 1937.

Lt. H. O. Cozby, (M. C.), U. S. N. Naval Delinquency. April 1937.

Lt. Comdr. Paul F. Dickens, (M. C.), U. S. N., and Lt. Omar J. Brown, (M. C.), U. S. N. Present Day Concepts of Endocrinology. January 1937.

Lt. Comdr. W. W. Hall, (M. C.), U. S. N. Active Immunization Against Tetanus with Tetanus Toxoid. January 1937.

Commander F. S. Johnson, (M. C.), U. S. N., and Arthur G. Vallee, Pharmacist's Mate, First Class, U. S. N. Liquid Insecticides, Report of Comparative Study of. July 1937.

Commander R. P. Parsons, (M. C.), U. S. N. An Estimate of Arsenoxide (Mapharsen) in the Treatment of Early Syphilis. April 1937.

NEW MEMBERS AMERICAN COLLEGE OF PHYSICIANS

The Secretary of the American College of Physicians has notified the Surgeon General that the following naval medical officers have been elected to membership in the American College of Physicians:

TO FELLOWSHIP

Comdr. John Harper (MC), U. S. N.
Comdr. Frederick L. McDaniel (MC), U. S. N.

TO ASSOCIATESHIP

Comdr. Earl Richison (MC), U. S. N.
Comdr. William P. Mull (MC), U. S. N.
Lt. Comdr. James G. Dickson (MC), U. S. N.
Lt. Bartholomew W. Hogan (MC), U. S. N.
Lt. Julian Love (MC), U. S. N.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review.)

THE PRACTICE OF MEDICINE, by *Jonathan Campbell Meakins, M. D., L. L. D.; professor of medicine, McGill University; physician in chief, Royal Victoria Hospital, Montreal, etc.* Cloth. 1343 pages. 5050 illustrations, including 35 colored plates. C. V. Mosby Co., St. Louis. Price $10.

This book is really a unique volume in many respects. The author has set out to write a clear concise treatise on the practice of medicine in one volume, which in itself in this day of specialization would at first appear to represent a heroic task. He has succeeded in producing a work of inestimable value to the internist, general practitioner, and medical student, in that without discussing the various diseases in monographic form, he has covered the field of medicine in a nearly encyclopedic manner, and at the same time, due to this extremely concise and clear English, and especially due to his faculty of stressing essentials, he has compiled what amounts to a system of medicine in one volume. In a large way this book reflects considered opinions of a master of medicine whose perspective has been widened and deepened by many years of clinical experience and teaching.

The numerous and well-chosen illustrations constitute a novel feature of great value.

AN INTRODUCTION TO MEDICAL SCIENCE, by *William Boyd, M. D., M. R. C. P. (Edinburgh), F. R. C. T. (London), professor of pathology in the University of Manitoba.* 307 pages, illustrated with 108 engravings. Lea & Febiger, Philadelphia. 1937. Price $3.50.

This is, as the author well states in his introduction, an "aeroplane review of diseases." It is intended for the premedical student, nurse, and the intelligent laymen who desire to gain a general picture of the human body, the diseases which afflict it, and the defenses which it makes against them. The whole is well-told in a brief way and with a number of simple but excellent illustrations.

Clinical Allergy, Manifestations, Diagnosis, and Treatment, by *Albert H. Rowe, M. S., M. D., lecturer in medicine in the University of California Medical School, San Francisco, Calif.; chief of the Clinic for Allergic Diseases of the Alameda County Health Center, Oakland, Calif.; president of the Association for the Study of Allergy, 1927–28.* Published by Lea & Febiger, Philadelphia. Price $8.50.

This book contains 16 chapters and an appendix, with a total of 706 pages of subject matter. In addition there is a most extensive and complete bibliography of 80 pages. Dr. Rowe has covered the subject of allergy exceptionally well, especially the part foods play in allergic conditions. He stresses the fact that a particular food may be the causative factor in an allergic condition, yet give a negative skin test by both the scratch and intradermal methods. The chapter dealing with "Rowe's Elimination Diet" and other diatetic management of food allergy is very valuable as an aid and guide in treatment.

Operative Surgery, by *J. Shelton Horsley, M. D., LL. D., F. A. C. S., attending surgeon, St. Elizabeth's Hospital, Richmond, Va.* and *Issac A. Bigger, M. D., professor of surgery, Medical College of Virginia.* 1,350 pages with numerous cuts, illustrations, photographs, charts, and drawings. 2 vols. (4th edition). Publishers, C. V. Mosby & Co., St. Louis. Cloth. $15.

This is the fourth edition of a work on operative surgery which, since 1921, has been recognized as belonging in the front rank of works of this kind. Dr. Horsley has secured the services of five contributing authors, all well known in surgical writing, for this newest edition. The result is a two-volume set which is very beautifully and expertly done. The paper, and especially the type, are exceptionally good.

The chapters on intestinal surgery, operations on the chest, plastic operations on the face, flap transplantation, grafts, and brain tumors are most interesting. We should like to have seen more emphasis laid upon the transurethral method of prostatectomy, as we are acquainted with one large clinic which performed but two suprapubic operations in a series of over 500 cases in 1 year, with a very high degree of success. We recommend these two books, without reserve, to all surgeons desiring a neat, compact, and competent account of modern operative technique.

Preoperative and Postoperative Treatment, by *Robert L. Mason, A. B., M. D., F. A. C. S., assistant in surgery at the Massachusetts General Hospital.* 495 pages, 123 illustrations. W. B. Saunders Co., Philadelphia. 1937. Price $6.

Dr. Mason presents a valuable and very useful book covering the pitfalls of both the patient and surgeon in and out of the operating room. With brilliant contributions by his Harvard and Massachusetts General Hospital associates, he has developed a book that covers, in general, the preoperative and postoperative management of the surgical patient. Estimation of the surgical risk, anesthesia, shock, blood transfusion, water balance, diet, and immediate and secondary complications are dealt with in a practical yet thorough manner.

The chapter devoted to burns is outstanding in merit. Then, in masterly fashion, part 2 takes up regional surgical problems, presents many excellent guides for the surgeon.

Handbook of Orthopaedic Surgery, by *Alfred Rives Shands, Jr., B. A., M. D., associate professor of surgery in charge of orthopaedic surgery, Duke University School of Medicine;* in collaboration with, *Richard Beverly Raney, B. A., M. D., instructor in orthopaedic surgery, Duke University School of Medicine.* 593 pages. 169 illustrations. The C. B. Mosby Co., St. Louis. 1937. Price $5.

The need for a complete handbook of orthopedic surgery is definite, not only for undergraduate orthopedic instruction but for the general practitioner as well. Dr. Shands in collaboration with Dr. Raney gives us a text book, elementary in type yet rich in helpful diagnostic guides and useful therapeutic suggestions. The book has been carefully prepared and covers the entire scope of congenital and acquired deformities. Each chapter has been critically reviewed before publication by leading American instructors in orthopedic surgery. The work covers well the needs of this important field of surgery.

Injuries and Diseases of the Hip, by *Fred H. Albee, M. D., LL. D., F. A. C. S., past president, American Orthopedic Association.*, assisted by, *Robert L. Preston, M. D., associate in orthopedic surgery, Columbia University.* 298 pages. 100 illustrations. Paul B. Hoeber, Inc., New York. Price $5.50.

A master bone surgeon delves into 30 years of pioneer experience in the difficult field of hip joint diseases and injuries. From wisdom born of operative and teaching experience unexcelled in the field of orthopedic surgery, he presents the first book ever written devoted entirely to the treatment of hip conditions. Twelve brilliant chapters detail his conservative and operative procedures. The book stresses the merits of his famous bone graft and the advantages obtained by the development of motor-driven tools, the modern fracture orthopedic table, and the double plaster spica.

Diseases of Infants and Children, by *J. P. Crozer Griffith, M. D., Ph. D., emeritus professor of pediatrics, University of Pennsylvania,* and *A. Graeme Mitchell, M. D., B. K. Rachford professor of pediatrics, College of Medicine, University of Cincinnati.* One octavo of 1154 pages, with 293 illustrations, including 18 in colors. Second edition thoroughly revised. 1937. W. B. Saunders Co., Philadelphia. Price $10.

This work, by two eminent authors, contains a wealth of information, well organized, well written, and well edited. It covers the whole field, clearly and concisely, without undue verbiage and is printed in a style that makes easy reading.

The discussions of many topics have been expanded, including disturbances of the acid-base balance, diabetes mellitus, and dehydration in gastroenteritis. The matter of artificial feeding has been put on a simpler basis in a 65-page monograph and particular attention has been devoted to the sections concerning growth and development and anatomy and physiology.

MEDICAL TREATMENT OF CATARACT, by *A. Edward Davis, M. D.* F. A. Davis Co.. Philadelphia, Pa. 161 pages. Price $3.

This volume is mostly concerned with senile cataract. The author advances the idea that senile cataract is a pathological process consisting of chemical changes in the protein of the lens fibers and not a physiological change incident to old age like graying of the hair or wrinkling of the skin. These chemical changes are the result of toxins acting upon the individual fibers of the lens. The toxins are engendered mainly by faulty metabolism which may result from some general disease, overeating, malnutrition, insufficient calcium, phosphorus, potassium or vitamines, or by endoctrine disturbance, especially the thyroid or parathyroid.

In the treatment the author stresses early diagnosis and claims that the progress of this type of cataract can be arrested in about 81 percent of the cases.

Treatment consists of subcutaneous injections of the lens antigen in increasing doses over a period of 6 months with local hot compresses and instillations of dionin. Diet is considered important, also plenty of vitamins and water.

The ideas advanced, if proven correct, should prove a valuable adjunct to our treatment of cataract.

THE OCULAR FUNDUS IN DIAGNOSIS AND TREATMENT, by *Donald T. Atkinson, M. D., F. A. C. S.* 258 pages with 106 illustrations, including 58 plates in natural colors. Lea & Febiger, Philadelphia, 1937, Price $10.

This is said to be the only book in English covering this subject in which the illustrations are wholly the work of the author.

There are 142 pages of printed matter, divided into 8 chapters, viz: (1) The Ophthalmoscope, (2) The Normal Fundus, (3) The Retinal Vessels, (4) The Optic Nerve, (5) The Vitreous Humor, (6) The Retina, (7) The Choroid, (8) Usual Ophthalmoscopic Manifestations in Special Disease.

The subject matter is each chapter is briefly and concisely discussed. There is a short discussion of the anatomy, the anomalies, diseased conditions, their appearance, and a few words on the latest methods of treatment. The 58 natural-color illustrations are beautifully done. Each illustration is accompanied by an adequate description.

The book should prove a very useful and practical addition to the ophthalmologist's library.

MICROSCOPICAL TECHNIQUE. Edited by *C. E. McClung, Ph. D., professor of zoology and director, Zoological Laboratory, University of Pennsylvania.* Cloth. Second edition, revised and enlarged. 698 pp., with 82 illustrations. Paul B. Hoeber, Inc., 1937. Price $8.

There are 34 well-known, highly specialized contributors to this excellent volume.

The various procedures and other data are given in a clear and concise manner. The bibliography is ample and well selected.

In the opinion of the reviewer some of the most valuable additions of the second edition are a complete, new dioxan technique for paraffin sections, methods of staining *boutons terminaux*, the fused quartz rod method of illuminating living structure, microincineration, the centrifuge microscope, and fluorescent microscopy.

This book should be of particular interest and great value to workers in microscopic anatomy, bacteriology, cytology, embryology, histology, and pathology.

FLYING VISTAS.—The human being as seen through the eyes of the flight surgeon. By *Isaac H. Jones, M. A., M. D., military aeronautics, U. S. A., during the World War; medical examiner, Bureau of Air Commerce, U. S. Department of Commerce.* 250 pages, 9 illustrations. J. B. Lippincott Co., Philadelphia and London. Price $2.

The book presents an interesting review of the problems confronting aviation at the beginning of the World War, together with the accomplishments of the War Department in devising and standardizing the physical requirements for flying, under the able direction of General Lyster. It explains in an interesting manner the various aspects of the physical examination for flying, and gives to the aviator and layman a practical understanding of the examination and the reasons therefor. The development of the specialty of aviation medicine and the flight surgeon are described. The book is nontechnical and is of particular interest to the flyer.

DENTAL PHARMACOLOGY AND THERAPEUTICS, *J. R. Blayney, B. S., D. D. S., M. S.* Second edition. C. V. Mosby Co., St. Louis, Mo. Price $4.

In the text of this volume, the names and compositions have been made to conform with those of the eleventh edition, United States Pharmacopoeia, and the sixth edition, National Formulary.

The text is divided into three parts. Part 1 is devoted to a general consideration of drugs, principle action, methods of administration, average doses, and prescription writing, in which the author recommends the use of English, the only exception being the use of some common Latin abbreviations; therefore, he has eliminated medical Latin from this volume.

Each main division of part 1 is followed by a number of problems which will make this work of especial value to the student.

In part 2, the consideration of drugs arranged according to their chief dental uses, still maintaining the usual pharmacologic grouping, which will be appreciated by both student and practitioner. The author presents an interesting and valuable introduction to each group of drugs as to their mode of action and standardization of efficiency.

Part 3. The student will find in this part valuable and interesting laboratory exercises.

This is an excellent presentation of the subject for the purpose intended. Its size alone will recommend it to those who would not undertake a more extensive discussion of the subject.

The printing is good, large type, well spaced, and well-selected illustrations bring it up to the usual standards of the publisher.

Essentials of Oral Surgery, by *Blair and Ivy*. Second edition, 606 pages, illustrated. C. V. Mosby & Co., St. Louis, Mo. Price $6.50.

This edition brings up to date the advances that have been made in the surgery of the mouth and jaws since publication of the first edition.

The order in which the different subjects are presented has been changed, primarily as an aid to the undergraduate, but should prove equally helpful to the general practitioner, who should be stimulated to recognize and better understand the many conditions of the mouth requiring surgical treatment.

The chapter on fractures of the jaw will be of invaluable assistance to many who are nowadays called upon for this service to their patients in this fast-moving age.

The chapter on surgical preparation of the mouth for artificial dentures is a concise presentation of a subject that should be of benefit not only to the oral surgeon but equally to the general practitioner, as well as the prosthodontist.

This volume is well written, spendidly illustrated, and the printing and binding are of the usual high standard of the publishers.

THE DIVISION OF PREVENTIVE MEDICINE

C. S. STEPHENSON, Commander, Medical Corps, United States Navy, in charge

TOXIC EFFECTS OF ARSENICAL COMPOUNDS EMPLOYED IN THE TREATMENT OF DISEASE IN THE UNITED STATES NAVY, 1936

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Since November 1924 medical officers of the Navy have been required to make monthly reports of the number of doses of arsenicals administered and a separate account of each case in which ill effects are noted. During the 12 years, 1925–36, in which this information has been compiled 1,202,261 doses of arsenicals have been administered and 924 reactions have been reported.

Previous articles dealing with the information obtained from these reports were published in the September 1925, January 1927, January 1929, July 1930, October 1931, October 1932, April 1933, October 1933, October 1934, January 1935, October 1935, January 1936, October 1936, January 1937, and October 1937 numbers of the United States Naval Medical Bulletin. Cases of arsenical dermatitis occurring during the year 1936 were published in the October 1937 number of the Naval Medical Bulletin. The present article deals with all cases, except arsenical dermatitis, which were reported during the year 1936. Comparative figures from the experience of previous years are also presented.

TABLE 1.—*Arsenical reactions, 1936*

Classification	Arsphenamine, neoarsphenamine, sulpharsphenamine, and tryparsamide reactions			
	Mild	Severe	Fatal	Total
Arsenical dermatitis [1]	14	18	2	34
Vasomoter phenomena	28	1	0	29
Jarisch-Herxheimer	4	0	0	4
Blood dyscrasias	1	2	0	3
Gastrointestinal	1	1	0	2
Hemorrhagic encephalitis	0	1	1	2
Liver damage	0	1	0	1
Optic neuritis	0	1	0	1
Total	48	25	3	76

[1] Case histories were published in the October 1937 number of the Bulletin. Included in the above table is 1 severe reaction caused by arsphenamine, 4 reactions, 2 mild and 2 severe, caused by sulpharsphenamine, and 1 severe reaction caused by tryparsamide.

TABLE 2.—*Arsenicals administered during the year 1936 for all diseases, including syphilis*

Drug	Dose				
	0.9 to 3 grams	0.9 gram	0.6 to 0.9 gram	Less than 0.6 gram	Total
Acetarsone:					
Navy	0	0	0	140	140
All others	0	0	0	0	0
Arsphenamine:					
Navy	0	0	0	2,603	2,603
All others	0	0	0	8	8
Bismarsen:					
Navy	0	0	0	341	341
All others	0	0	0	68	68
Mapharsen:					
Navy	0	0	0	1,555	1,555
All others	0	0	0	747	747
Neoarsphenamine:					
Navy	0	275	32,046	46,826	79,147
All others	0	7	3,560	10,193	13,760
Silver arsphenamine:					
Navy	0	0	0	61	61
All others	0	0	0	14	14
Sulpharsphenamine:					
Navy	0	0	98	1,456	1,554
All others	0	0	0	971	971
Tryparsamide:					
Navy	4,148	0	0	0	4,148
All others	924	0	0	0	924
Total	5,072	282	35,704	64,983	106,041

TABLE 3.—*Arsenicals administered during the 5-year period, 1932–36, for all diseases, including syphilis*

Drug	Dose				
	0.9 to 3 grams	0.9 gram	0.6 to 0.9 gram	Less than 0.6 gram	Total
Acetarsone:					
Navy	0	0	0	140	140
All others	0	0	76	729	805
Arsphenamine:					
Navy	0	0	81	9,121	9,202
All others	0	0	0	111	111
Bismarsen:					
Navy	0	0	0	752	752
All others	0	0	1	548	549
Mapharsen:					
Navy	0	0	0	1,993	1,993
All others	0	0	0	882	882
Neoarsphenamine:					
Navy	0	4,758	198,435	284,296	487,489
All others	0	380	24,584	78,969	103,933
Silver arsphenamine:					
Navy	0	0	0	340	340
All others	0	0	0	204	204
Sulpharsphenamine:					
Navy	0	18	241	6,801	7,060
All others	0	3	43	8,810	8,856
Tryparsamide:					
Navy	15,931	0	0	10	15,941
All others	8,965	0	0	5	8,970
Total	24,896	5,159	223,461	393,711	647,227

TABLE 4.—*Deaths and severe reactions following the administration of 1,087,083 doses neoarsphenamine, 1925–36. Ratio of deaths and severe reactions to doses*

Classification	Deaths		Severe reactions		Deaths and severe reactions	
	Number	Ratio to doses 1 to—	Number	Ratio to doses 1 to—	Number	Ratio to doses 1 to—
Hemorrhagic encephalitis	15	72,472	1	1,087,083	16	67,943
Arsenical dermatitis	10	108,708	170	6,395	180	6,039
Vasomotor phenomena	6	181,181	56	19,412	62	17,534
Blood dyscrasias	5	217,417	18	60,394	23	47,264
Acute renal damage	2	543,542	5	217,417	7	155,298
Acute yellow atrophy of the liver	2	543,542	0		2	543,542
Vascular damage (probable renal hemorrhage)	1	1,087,083	0		1	1,087,083
Liver damage	0		14	77,649	14	77,649
Jarisch-Herxheimer	0		2	543,542	2	543,542
Polyneuritis	0		1	1,087,083	1	1,087,083
Border-line hemorrhagic encephalitis	0		1	1,087,083	1	1,087,083
Arsenical neuritis	0		1	1,087,083	1	1,087,083
Gastrointestinal	0		2	543,542	2	543,542
Optic neuritis	0		1	1,087,083	1	1,087,083
Total	41	26,514	272	3,997	313	3,473

TABLE 5.—*Deaths following administration of arsenical compounds, 1919–36*

Year	Arsphenamine	Neoarsphenamine	Total	Year	Arsphenamine	Neoarsphenamine	Total
1919	3	0	3	1929	0	3	3
1920	1	1	2	1930	0	3	3
1921	3	1	4	1931	0	0	0
1922	0	4	4	1932	0	4	4
1923	0	1	1	1933	0	7	7
1924	1	2	3	1934	0	3	3
1925	0	2	2	1935	0	2	2
1926	0	4	4	1936	0	3	3
1927	1	4	5				
1928	0	6	6	Total	9	50	59

NUMBER OF PERSONS TREATED FOR SYPHILIS AND OTHER DISEASES

Annually on December 31 each activity records and reports to the Bureau of Medicine and Surgery, on N. M. S. Form A, the number of persons in that command who have a history of syphilis, and the number of those in the command who were treated during the year with an arsenical compound, heavy metal, or other antiluetic treatment. The census also requires the recording and reporting of the number of persons who were treated during the year with an arsenical compound for a disease other than syphilis. This census does not take into account those individuals who left the service during the year.

In the table which follows, treatment data have been separated into that given to active service personnel and that given to all others. The term "All other" includes Veterans' Administration patients, dependents of naval personnel, retired naval personnel, and native populations of insular possessions.

TABLE 6.—*Syphilis and arsenicals, U. S. Navy, 1936*

	Persons		
	United States Navy and Marine Corps	All other	Total
Strength, Dec. 31, 1936	126, 583		126, 583
Syphilis census, Dec. 31, 1936	14, 427		14, 427
Number of persons treated for syphilis with—			
Arsenicals:			
Arsphenamine	153	23	176
Bismarsen	15	25	40
Mapharsen	141	101	242
Neoarsphenamine	5, 402	1, 173	6, 575
Silver arsphenamine	7	2	9
Sulpharsphenamine	167	42	209
Tryparsamide	225	71	296
Total persons treated with arsenicals	6, 110	1, 437	7, 547
Heavy metal compounds:			
Bismuth compounds	5, 289	863	6, 152
Mercury compounds	527	36	563
Mixed treatment (specific mixture, etc.)	142		142
Potassium iodide	214	10	224
Total persons treated with heavy metal compounds	6, 172	909	7, 081
Number of persons treated for disease other than syphilis with arsenicals:			
Arsphenamine	30		30
Neoarsphenamine	164	1, 199	1, 363
Sulpharsphenamine	1	74	75
Fowler's solution	192		192
Total persons treated with arsenicals	387	1, 273	1, 660
Heavy metal compounds:			
Bismuth compounds	0	69	69

In table 6 it will be noted that 387 service personnel and 1,273 nonservice personnel were treated for diseases other than syphilis with arsenical compounds during the year 1936.

Of the 387 naval personnel, 323 were treated for Vincent's infection, 8 for furunculosis, 6 for dermatitis herpetiformis, 5 for acne, 5 for yaws, and 9 for other diseases.

Of the 1,273 persons in the group "all others," 1,195 were treated for yaws, 76 for Vincent's infection, and 2 for other diseases.

VASOMOTOR PHENOMENA

Neoarsphenamine.—(35—1936.) This patient (supernumerary, native of Guam) was given a diagnosis of syphilis because of clinical and serological findings.

Arsenical treatment began December 18, 1935, with a 0.25 gram injection of neoarsphenamine. Two hours after the injection the patient developed chills and headache, a temperature of 103.4° F.; pulse, 120; and respirations, 28.

Recovery within 24 hours.

Arsenical treatment was continued and after the fourth injection of neoarsphenamine the patient developed severe exfoliative dermatitis and died 20 days after the onset of the first symptoms. (Case No. 33–1936—U. S. Naval Medical Bulletin, October 1937).

(36—1936.) After exposure to infection February 10, 1936, a patient developed several small abrasions on the shaft of the penis. One month later he was given a diagnosis of syphilis because of secondary rash and a 4-plus Kahn blood test.

Arsenical treatment was begun and he received three injections of neoarsphenamine, a total of 1.5 grams, and six injections of bismosol between March 9 and 26, and 0.45-gram injections of neoarsphenamine on April 2, 9, and 16. About 1 hour after the last injection, and after eating dinner, the patient developed chills with a numblike sensation over the entire body, followed by nausea and vomiting. He was given 1 gram of sodium thiosulphate intravenously.

Recovery within 6 hours.

Arsenical treatment was continued and he received a 0.2 gram injection of neoarsphenamine and a 0.2 gram injection of bismosol on April 23 and a 0.3 gram injection of neoarsphenamine on April 30. Five hours after the last injection of neoarsphenamine the patient developed symptoms similar to the previous reaction, followed in 3 days by a severe exfoliative dermatitis. (Case No. 18–1936—U. S. Naval Medical Bulletin, October 1937).

(37—1936.) A patient, exposed to infection November 1, 1935, developed a lesion on the penis. Repeated dark-field examinations were negative for *Treponema pallidum*. He was given a diagnosis of syphilis 2 months later because of a 3-plus Kahn blood test.

Arsenical treatment began January 30, 1936, with a 0.25 gram injection of neoarsphenamine. Six hours after the injection he developed nausea and vomiting. Temperature 102.4° F. He was given 1 gram of sodium thiosulphate intravenously. Temperature returned to normal within 6 hours.

Recovery within 24 hours.

(36, 39—1936.) This patient (supernumerary, native of Guam) experienced two mild vasomotor phenomena reactions during the first course of arsenical treatment. The patient was given a diagnosis of yaws because of an ulceration on the left foot, lymphadenopathy, and a 4-plus Kahn blood test.

Arsenical treatment was started December 27, 1935, with a 0.25 gram injection of neoarsphenamine. Two hours after the injection the patient developed a severe headache. Temperature 103° F.; pulse, 110; and respirations, 26.

Recovery within 24 hours.

Arsenical treatment was continued with a 0.4 gram injection of neoarsphenamine January 8, 1936. Two hours after this injection the patient developed moderate chills and headache. Temperature of 102° F., pulse, 106; and respirations, 26.

Recovery within 24 hours.

(40—1936.) This patient (supernumerary, native of Guam), was given a diagnosis of yaws because of clinical and serological findings.

Arsenical treatment began January 30, 1936, with a 0.25 gram injection of neoarsphenamine. Two injections of bismosol were given as concurrent treatment.

Three hours after the injection of neoarsphenamine the patient developed chills, headache, nausea, and vomiting. Temperature 105° F.; pulse, 150; and respirations, 45. One gram of sodium thiosulphate was given intravenously.

The following day the patient complained of slight headache, had four liquid stools during the day. Temperature 102.8° F.; pulse, 100; and respirations, 26.

Recovery in 2 days.

(41—1936.) A patient, exposed to infection March 1934, developed a primary lesion on the penis May 1, 1934, and was given a diagnosis of syphilis because of clinical and serological findings.

Arsenical treatment was instituted June 5, 1934, with a 0.2 gram injection of sulpharsphenamine, followed by a 0.4 gram injection on June 12. From July 3, 1934, to July 23, 1935, he received 30 injections of neoarsphenamine, a total of 17.4 grams, and 40 injections of bismuth salicylate as concurrent treatment.

On October 25, 1935, the fifth course of arsenical treatment began with a 0.3 gram injection of neoarsphenamine, followed by a 0.45 gram injection on November 1, and 0.6 gram injections on November 22, 29, December 6, 13 and 23, 1935, and a 0.3 gram injection on January 4, 1936.

During the progress of the last injection, the patient complained of aching in the arm followed by slight faintness and nausea. He was given 0.5 cubic centimeter of adrenalin hypodermatically. The patient continued to complain of the arm aching. There was no evidence of leakage into the tissue. He was treated locally with sodium thiosulphate. All symptoms other than the pain in the arm subsided. Red blood count, 4,450,000; white blood count, 11,300; hemoglobin, 90 percent; segments 63; lymphs, 21; bands, 13; juveniles, 3.

Recovery in 6 days.

(42—1936.) A patient who was exposed to infection February 10, 1931, developed a small indurated ulcer on the penis which was positive for *Treponema pallidum*.

From March 7, 1931, to May 18, 1934, he received 33 injections of salvarsan and 33 injections of bismuth salicylate (total amount not recorded); from March 8 to November 8, 1935, 22 injections of neoarsphenamine, a total of 11.8 grams, and 10 injections of bismuth salicylate as concurrent treatment; and on January 16, 1936, a 0.45 gram injection of neoarsphenamine, the first injection of the seventh course of arsenical treatment. Twenty minutes after the injection he suffered a severe chill and complained of a choking feeling. Temperature 100.8° F.; pulse, 100; and respirations, 19. He was given 1 gram of sodium thiosulphate intravenously, and 1 gram by mouth, repeated the following day. All symptoms disappeared within 3 hours after sodium thiosulphate was administered January 16.

Recovery in 1 day.

(43—1936.) The source of infection in this case is unknown. The patient was given a diagnosis of syphilis because of general adenopathy, falling hair of the eyebrows and head, and repeated 4-plus Kahn blood tests.

He was given a 0.25 gram injection of neoarsphenamine on January 16, 1936, and a 0.3 gram injection on January 23. Two injections of bismosol were given as concurrent treatment.

Five hours after the last injection of neoarsphenamine the patient developed a slight chill, followed by a temperature of 103.6° F.; pulse, 108; and respirations, 25. Examination showed injected conjunctivae and flushed face. He complained of dizziness and intense aching of the joints. One-half cubic centimeter of adrenalin was administered subcutaneously. White blood count, 10,800; bands 8; segments, 68; lymphs, 17; monos, 5; eosins, 2. It was believed that the patient had a mild reaction coincident with catarrhal fever. All symptoms disappeared within 3 days.

He was given 0.1 gram of sulpharsphenamine intramuscularly on February 2, 1936. Six hours later he complained of slight headache and chills. Examination showed the eyes injected and mucous membranes of the mouth and throat injected and edematous. Temperature, 99° F.; pulse, 80; and respiration, 20. White blood count, 16,200; bands, 14; segments, 75; lymphs, 5; monos, 5; eosins, 1. Symptoms disappeared the following day and the patient felt well.

The patient was considered recovered in 13 days but was kept on the sick list 20 additional days for observation and treatment with sulpharsphenamine. No reaction occurred following the next four injections of sulpharsphenamine.

(44—1936.) A patient was given a diagnosis of syphilis because of positive dark-field examination of a sore on the penis, general adenopathy, and secondary skin rash.

From March 26 to May 11, 1936, he received eight injections of neoarsphenamine, a total of 4.5 grams, and eight injections of bismosol.

The second course of arsenical treatment was started June 15, 1936, with a 0.3-gram injection of neoarsphenamine, followed by a 0.4-gram injection on June 22, and 0.6-gram injections on June 29, July 6, 13, and 20. He was given six injections of bismosol as concurrent treatment.

Two minutes after the last injection of neoarsphenamine the patient became dizzy, weak, and faint. The face was flushed, pulse rapid, and blood pressure low.

Recovery within 6 hours.

(45—1936.) A patient exposed to infection October 11, 1934, developed several small ulcers on the glans penis which were positive for *Treponema pallidum*. The glands were moderately enlarged and a Kahn blood test was 4-plus.

From November 27, 1934, to February 26, 1936, he received a total of 8.6 grams of neoarsphenamine and 4.19 grams of arsphenamine (number of injections not recorded). As concurrent treatment he was given 23 injections of bismosol, 20 mercury inunctions, and potassium iodide daily for 2 months.

The fourth course of arsenical treatment was begun January 22, 1936, with a 0.3-gram injection of neoarsphenamine, followed by a 0.35-gram injection on January 28; 0.3 gram of arsphenamine February 8, 0.4 gram February 15, and 0.3 gram February 20; and 0.27 gram of neoarsphenamine February 26.

Three and one-half hours after the last injection of neoarsphenamine the patient reported complaining of chills and fever. Examination showed convulsive movement of the right arm, which he was not able to control. His temperature rose to 103° F. and fell rapidly after he received 5 minims of adrenalin intramuscularly, and 1 gram of sodium thiosulphate.

Recovery in 1 day.

(46—1936.) A patient who was exposed to infection on January 28, 1934, developed a small ulcer on the penis and glandular adenopathy. Repeated Kahn blood tests were 4-plus.

From March 20 to May 29, 1934, he received eight injections of neoarsphenamine (total amount not recorded). From November 6, 1934, to October 22, 1935, he was given 24 injections of neoarsphenamine, a total of 13.05 grams. Thirty injections of bismosol and 13 injections of mercury bichloride were given as concurrent treatment.

The fifth course of arsenical treatment began January 7, 1936, with a 0.3-gram injection of neoarsphenamine, followed by a 0.45-gram injection on January 14 and 0.6-gram injections on January 21, 28, February 4, 11, 18, 27, and March 2.

Within 1½ hours after the last injection the patient developed a sense of chillness, mild headache, and a heavy feeling in the abdomen. One-half hour later he had a distinct chill, after which he slept for 2 hours.

Recovery within 6 hours.

(47—1936.) A patient was exposed to infection August 1934. Two months later he developed a secondary skin rash and generalized adenopathy. The Kahn blood test was 4-plus.

From October 19, 1934, to October 17, 1935, he received 20 injections of neoarsphenamine, a total of 9.9 grams, and 15 injections of bismuth salicylate as concurrent treatment.

The third course of arsenical treatment began January 30, 1936, with a 0.3-gram injection of neoarsphenamine, followed by a 0.45-gram injection on February 6, 0.6-gram injections on February 13 and 20, and a 0.3-gram injection on March 12, 1936. Three minutes after the last injection he became nauseated and vomited bile-stained stomach contents. He complained of weakness and aching of the spine and extremities; the eyes were dilated and conjunctivae injected; the face was cyanotic; the heart beats were barely noticeable, the radial and temporal pulse not obtainable; respirations were slow and shallow; involuntary urine and bowel movement.

The patient presented a typical picture of profound shock. He was apparently unconscious for about 10 minutes and was in a semiconscious condition for 1 hour. Red blood count, 4,910,000; white blood count, 16,400; hemoglobin, 90 percent; myelocytes, 3; juveniles, 8; bands, 34; segments, 47; lymphs, 8. He was given

0.5 cubic centimeter of adrenalin and 1/100 grain of atropin subcutaneously at intervals as appeared to be indicated.

The patient felt normal the following day.

Recovery in 4 days.

(48—1936.) A patient, exposed to infection on November 14, 1934, developed a sore on the penis which was positive for *Treponema pallidum*.

From November 19, 1934, to November 16, 1935, he received 16 injections of neoarsphenamine, a total of 6.9 grams; 10 injections of arsphenamine, a total of 3.7 grams; and 33 injections of bismuth as concurrent treatment.

The fourth course of arsenical treatment began February 29, 1936, with a 0.3-gram injection of arsphenamine, followed by a 0.3-gram injection on March 7, and a 0.3-gram injection of neoarsphenamine on April 7. Thirty minutes after the injection of neoarsphenamine the patient developed weakness, nausea, and light vomiting.

Recovery within 5 hours.

The patient complained of slight reaction following each attempt to give neoarsphenamine but had no complaint after receiving arsphenamine.

(49—1936.) This patient was exposed to infection in November 1935. He was given a diagnosis of syphilis January 18, 1936, because of secondary skin rash, mucous patches in the mouth, generalized adenopathy, positive dark-field examination of a penile lesion, and a 4-plus Kahn blood test.

From January 21 to March 3, 1936, he received 6 injections of neoarsphenamine (amount not recorded) and 10 injections of bismuth salicylate.

The second course of arsenical treatment began May 21, 1936, with a 0.3-gram injection of neoarsphenamine, followed by a 0.45-gram injection on May 28, and a 0.11-gram injection on June 4. Seven injections of bismuth were given as concurrent treatment.

Approximately 1 minute after the last injection of neoarsphenamine was started, and after receiving 0.11 gram of the 0.6-gram dose, the patient remarked that the neoarsphenamine must be stronger than usual because he could taste it much more than before. It was noted that he was becoming somewhat cyanotic and the injection was stopped. The patient collapsed a few seconds later losing consciousness. Breathing became stridulous and difficult, the face cyanotic and puffed. He was given 5 cubic centimeters of adrenalin hypodermatically, repeated in 3 minutes. Breathing became easier and he recovered consciousness within 5 minutes. He complained of a choking sensation and severe pain in the right chest and was given 0.7 gram of sodium thiosulphate intravenously. In 40 minutes there was a slight chill and a temperature of 101° F.

Recovery within 24 hours.

(50—1936.) The diagnosis of syphilis in this case was not established. Physical examination showed no evidence of primary or secondary lesions in the skin, mucous membranes, or glandular involvement. The patient had negative monthly Kahn blood tests during the past year and a half while on the donors' list. A Kahn blood test was 3-plus May 2 and 4-plus May 4 and 5.

Treatment began on May 7 with a 2 cubic centimeters injection of bismuth sodium tartrate, followed by 2 cubic centimeters injections on May 8, 12, 15, 19, 22, and 26. Arsenical treatment began with a 0.35-gram injection of neoarsphenamine on May 12, followed by a 0.35-gram injection on May 19, and a 0.7-gram injection on May 26.

Three days after the last injection of neoarsphenamine the patient complained of sore throat, fever, and general malaise. He stated that he had not felt well the past week or 10 days, and thought it was the after effect of a spinal puncture. Examination revealed the throat and gums slightly reddened, tonsils elevated, and a temperature of 103° F. He was given 1 gram of sodium thiosulphate intraven-

ously twice daily for 9 days. All symptoms subsided by June 7, 1936, and the patient felt well.

The patient was considered recovered in 8 days, but he remained on the sick list 21 days for observation and treatment with bismuth compounds. The administration of sodium thiosulphate was continued and he received 1 gram intravenously daily for 5 days, a total of 32 grams within 21 days.

(51—1936.) After exposure to infection in May 1927 this patient developed a penile lesion which healed under local treatment. He was given a diagnosis of syphilis 3 months later because of repeated 4-plus Kahn blood tests.

He received seven injections of neoarsphenamine during the months of August and September 1927 (amount not recorded). From October 5, 1927, to September 5, 1933, he received 73 injections of neoarsphenamine, a total of 48.6 grams; 65 injections of bismuth salicylate; 14 injections of bismosol; 12 injections of mercury salicylate; and 37 mercury inunctions. From January 15 to November 26, 1935, he was given 19 injections of tryparsamide, a total of 57 grams, and 21 injections of bismosol.

The thirteenth course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on May 5, 1936, followed by 0.6-gram injections on May 12, 19, and June 2. Forty-five minutes after the last injection the patient complained of weakness and dyspnea. Examination revealed anxiety, suffused skin, rapid pulse, and a temperature of 101° F.

He was given 1 gram of sodium thiosulphate intravenously and 1 cubic centimeter of adrenalin hydrochloride subcutaneously.

Recovery within 24 hours.

(52—1936.) A patient, exposed to infection January 6, 1936, developed a lesion on the prepuce which was positive for *Treponema pallidum*. The inguinal glands were enlarged and discrete and a Kahn blood test was 4-plus.

From January 27 to March 24, 1936, he received eight injections of neoarsphenamine, a total of 4.7 grams, and three injections of bismuth.

The second course of arsenical treatment began June 2, 1936, with a 0.35-gram injection of neoarsphenamine, followed by 0.7-gram injections on June 9, 16, and 30. Thirty minutes after the last injection the patient complained of general malaise, nausea, and vomiting. Examination otherwise essentially negative. The patient stated that he had felt chilly, ached all over, and had sometimes been nauseated following the three previous injections of neoarsphenamine.

Recovery within 18 hours.

(53—1936.) This patient experienced two mild vasomotor phenomena reactions during the first course of arsenical treatment in 1934 (Case no. 12, U. S. Naval Medical Bulletin, January 1936). He was given a diagnosis of syphilis because of repeated 4-plus Kahn blood tests, inguinal lymphadenopathy, and a healed primary lesion of the glans penis.

From February 23 to April 5, 1934, he received 13 injections of neoarsphenamine, a total of 5.45 grams. The reactions followed the last two injections; the first followed a 0.45-gram dose and the second followed a test dose of 0.3 gram. Recovery in both cases was within 48 hours.

From April 12 to June 11, 1934, he was given 18 injections of bismosol. From February 8 to May 28, 1935, he was given 17 injections of mercury succinimide, a total of 3.4 grains.

The second course of arsenical treatment (five injections of neoarsphenamine, a total of 1.8 grams) was given between June 5 and July 11, 1935. Neoarsphenamine was discontinued because of slight reactions following the fourth and fifth injections.

From July 12, 1935, to June 12, 1936, he received 30 injections of bismuth salicylate and 20 injections of mercury succinimide.

A third course of arsenical treatment was attempted on July 8, 1936, with a 0.15-gram injection of neoarsphenamine. On July 15, 1½ hours after a 0.3-gram injection of neoarsphenamine had been administered, the patient developed headache, burning of the eyes, and general weakness. Temperature 100° F. Two hours later he became nauseated and vomited several times. He was given 1 gram of sodium thiosulphate intravenously.

Recovery within 10 hours.

(54—1936.) This patient gives a history of repeated exposures to infection several weeks prior to the appearance of a lesion on the glans penis on June 20, 1936. Repeated dark-field examinations of the lesion were negative for *Treponema pallidum*. A Kahn blood test on June 23 was 4-plus.

Arsenical treatment began with a 0.6-gram injection of neoarsphenamine on June 29, followed by 0.6-gram injections on July 6, 13, 20, and 27. As concurrent treatment he was given six intramuscular injections of bismosol.

Immediately following the last injection of neoarsphenamine the patient complained of feeling weak, dizzy, and faint, following which he became nauseated and vomited. Examination showed the face flushed, pulse rapid, and blood pressure low. He was given 1 gram of sodium thiosulphate intravenously and kept on the sick list for observation and complete rest.

On August 10 the patient was given a 0.6-gram injection of neoarsphenamine, following which the patient suffered a mild shock, became nauseated, and vomited. One-half gram of sodium thiosulphate was given intravenously.

Recovery in 16 days after onset of the first symptoms.

(55–1936.) The source of infection in this case is unknown. The patient denies venereal infection though he admits exposure to infection during the past 12 weeks. He was given a diagnosis of syphilis because of repeated 4-plus Kahn blood tests.

Arsenical treatment began with a 0.3-gram injection of neoarsphenamine on June 29, 1936, followed by a 0.4-gram injection on July 6, 0.6-gram injections on July 13 and 20, and a 0.3-gram injection on July 27. Five injections of bismosol were given as concurrent treatment.

Immediately following the last injection of neoarsphenamine the patient vomited and suffered shock, fall in blood pressure, and pulse rate. The eyelids and lips showed angioneurotic edema. He developed difficulty in breathing, cyanosis, and weakness. He was given 1 gram of sodium thiosulphate intravenously, followed by 1 cubic centimeter of epinephrine hydrochloride every 15 minutes for three hypodermic injections.

Recovery within 48 hours.

(56 and 57—1936.) This patient experienced two mild vasomotor reactions during the first course of arsenical treatment. He was infected on August 23, 1936, and 14 days later developed a lesion on the penis which was positive for *Treponema pallidum*.

He received a 0.3-gram injection of neoarsphenamine, and a 0.13-gram injection of bismuth salicylate on September 8, 1936. Twelve hours after the injection of neoarsphenamine the patient complained of headache. Temperature 103.6° F. The face was flushed and the mucous membranes were injected.

Recovery within 24 hours.

Arsenical treatment was continued with a 0.15-gram injection of neoarsphenamine on September 14. Seven hours after this injection the patient complained of headache. Temperature 99.8° F. The following morning his temperature was normal and all symptoms had subsided.

Recovery within 24 hours.

Neoarsphenamine was discontinued and bismarsen administered intramuscularly. There were no signs of further reaction.

(58—1936.) A patient exposed to infection in October 1927 developed a lesion on the penis which was positive for *Treponema pallidum.*

From May 10, 1927, to April 7, 1928, he received 16 injections of neoarsphenamine (amount not recorded) and from May 10, 1930, to July 17, 1936, 36 injections of bismuth compounds.

The third course of arsenical treatment began September 1, 1936, with a 0.1-gram injection of neoarsphenamine, followed by a 0.3-gram injection on September 4, and a 0.45-gram injection on September 8. About 10 minutes after the last injection the patient became nauseated and vomited profusely, followed by severe chills and collapse. The skin was flushed and pulse weak and rapid. He was given 1 gram of sodium thiosulphate intravenously and 5 cubic centimeters of adrenalin subcutaneously.

Recovery within 24 hours.

(59—1936.) This patient was exposed to infection in December 1931. He stated that a small sore developed on the penis 3 weeks after exposure and healed without treatment. He was given a diagnosis of syphilis on June 1, 1932, because of 4-plus Kahn blood tests and old scar on the glans penis.

From June 8 to August 3, 1932, he received eight injections of neoarsphenamine and eight injections of bismuth salicylate; from September 7 to October 11, five injections of neoarsphenamine; and from November 30 to December 27, five injections of neoarsphenamine (total amounts of the above treatment were not recorded). The patient stated that the second and third courses of arsenical treatment were discontinued after the fifth injection, because of slight gastrointestinal upsets, and fever.

From October 12, 1933, to July 24, 1936, he was given 22 injections of bismosol, 15 injections of bismuth salicylate, and 12 injections of mercury.

The fourth course of arsenical treatment began with a 0.3-gram injection on August 12, 1936, followed by a 0.45-gram injection on August 19, 0.6-gram injections on August 26 and September 16, and a 0.3-gram injection on September 23. One hour after the last injection the patient complained of headache, became nauseated, and vomited. He vomited at frequent intervals for 2 hours. He was given 1 cubic centimeter of adrenalin subcutaneously and 1 gram of sodium thiosulphate intravenously.

Recovery in 2 days.

(60—1936.) This patient was exposed to infection on March 26, 1934, and developed an indurated ulcer of the glans penis which was positive for *Treponema pallidum.*

From April 17 to June 19, 1934, he received 8 injections, a total of 3.6 grams of neoarsphenamine; from June 19 to July 9, 4 injections of sulpharsphenamine, a total of 1.3 grams; and from April 17, 1934, to January 15, 1935, 36 injections of bismosol.

On February 5, 1935, he received a 0.3-gram injection of sulpharsphenamine, followed by a 0.4-gram injection on February 12 and a 0.3-gram injection on February 19. A mild vasomotor phenomena reaction followed the last injection.

Recovery within 5 hours. (Case no. 42—1935, U. S. NAVAL MEDICAL BULLETIN, January 1937.)

From January 15, 1935, to September 22, 1936, he received 74 injections of bismuth compounds.

On September 29, 1936, he was given a 0.045-gram injection of neoarsphenamine, followed by a 0.09-gram injection on October 13. Five minutes after the last injection the patient complained of headache, and pain in the epigastrium, back, and legs. He vomited several times, followed by three watery bowel movements within 2 hours. One and one-half hours later he developed a severe chill and temperature of 101.4° F. He was given 5 minims of epinephrine hydrochloride,

1–1000 solution subcutaneously, followed by 1 gram of sodium thiosulphate intravenously.

Recovery within 24 hours.

(61–1936.) A patient, exposed to infection on March 10, 1936, developed three indurated ulcers on the glans penis which were positive for *Treponema pallidum.*

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on April 20, 1936, followed by 0.4 gram injections of arsphenamine on April 23 and 30. From May 6 to June 3 he received five injections, a total of 2.55 grams of neoarsphenamine. On June 13 he was given a 0.4 gram injection of arsphenamine and on June 25, a 0.3 gram injection of neorasphenamine. From September 12 to October 3, 1936, he received four injections of arsphenamine, a total of 1.2 grams. As concurrent treatment he was given 10 injections of bismuth salicylate.

On October 12, 1936, the patient was given a 0.27-gram injection of neoarphenamine and 15 minutes later he complained of general weakness and pains in the epigastrium. He became nauseated and vomited. He vomited twice and passed three watery stools within 1 hour. He developed a chilly sensation which lasted 45 minutes. Temperature, 99.4° F.

Recovery within 24 hours.

(62–1936.) After exposure to infection this patient developed a small punched-out ulcer on the inner surface of the foreskin which was positive for *Treponema pallidum.*

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on November 27, 1936. Two days after the injection the patient was admitted to the sick list with a temperature of 102° F. and pulse 120. Examination revealed a bubo in the right inguinal region, probably the result of the chancre and the cause of the elevated temperature. The patient had no other complaints or symptoms. Temperature returned to normal within 2 days. Arsenical treatment was continued and he was given a 0.6 gram injection of neoarsphenamine on December 3, 1936, without signs or symptoms of further reaction, followed by a 0.6 gram injection on December 10. Three hours after the last injection the patient complained of general malaise. Temperature, 103° F.; and pulse, 120. Examination negative other than high fever. He was given 1 gram of sodium thiosulphate intravenously. The patient slept confortably during the night and the following morning his temperature was 100° F. He was given the second 1 gram intravenous injection of sodium thiosulphate. Temperature gradually returned to normal.

Recovery in 8 days.

Sulpharsphenamine.—(63–1936.) This patient was given a diagnosis of syphilis on June 24, 1932, because of a secondary skin eruption, large indurated inguinal glands, 4-plus Kahn blood tests, and a history of exposure and a primary lesion of the penis in April 1932.

From June 24, 1932, to July 12, 1933, he received 28 injections of arsenical compounds (type and amount not recorded), 42 injections of bismuth compounds, and 19 injections of mercury. It was noted in the health record that arsenicals were discontinued in 1933 because of severe reaction to treatment.

During the years of 1934 and 1935 he was given 54 injections of bismuth compounds.

On February 11, 1936, he was given a 0.1 gram intramuscular injection of sulpharsphenamine, followed by a 0.2 gram injection on February 19. One hour after the last injection the patient developed a chill which lasted 1½ hours. Temperature, 101.2° F. Three hours after the injection he became nauseated and vomited. The patient complained of a slight headache the following morning.

Recovery in 2 days.

GASTROINTESTINAL

Sulpharsphenamine.—(64—1936.) The source and date of infection in this case is unknown. The patient was given a diagnosis of syphilis because of a secondary skin eruption and repeated 4-plus Kahn blood tests.

Arsenical treatment was instituted and from March 17, 1933, to May 4, 1934, he received a total of 11.65 grams of arsenical compounds (type and number of injections not recorded), 24 injections of bismosol, and 10 injections of mercury. From January 14 to August 3, 1936, he was given 16 injections of bismuth compounds.

He was given 0.3 gram intramuscular injections of sulpharsphenamine on August 11 and 17, 1936. One-half hour after the last injection of sulpharsphenamine the patient developed nausea, followed by vomiting and diarrhea. The vomitus contained macroscopic blood. One gram of sodium thiosulphate was administered intravenously. Two days later he developed slight bleeding from the gums and rectum. Physical examination otherwise negative. Red blood count, 4,100,000; white blood count, 5,650; hemoglobin, 80 percent; bands 33; segments 42; lymphs 17; monos 5; eosins 2; juveniles 1. Blood platelets, 341,000.

Recovery in 11 days.

Neoarsphenamine.—(65—1936.) This patient was exposed to infection on March 27, 1929, and developed a primary lesion on the prepuce which was positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

From May 7, 1929, to November 9, 1930, he received three courses of neoarsphenamine, a total of 15.9 grams, and 6 grains of mercury intramuscularly.

The fourth course of arsenical treatment began with a 0.3 gram injection of neoarsphenamine on June 6, 1936, followed by a 0.4 gram injection on June 13.

On June 22, 1936, the patient reported for the third injection of this course of neoarsphenamine. He stated that slight nausea and vomiting followed the injections given on June 6 and 13. He was given 1 gram of sodium thiosulphate intravenously followed in 1 hour by a 0.4 gram injection of neoarsphenamine. Immediately after the injection of neoarsphenamine he became pale and nauseated, followed by abdominal colic and watery stools. The patient was in moderate shock, with a temperature of 97° F.; pulse weak and rapid and the skin pale and cold. He was given 1 gram of sodium thiosulphate intravenously the following day.

Recovery in 9 days.

JARISCH HERXHEIMER

(66—1936.) This patient was exposed to infection December 18, 1935, and developed a lesion on the penis which was negative for *Treponema pallidum*. Under treatment, the lesion healed within 10 days.

He was given a 0.6 gram injection of neoarsphenamine on January 21, 1936. One hour after the injection the patient complained of general body pains and chills. Temperature, 102° F. He was given 0.5 cubic centimeter of adrenalin hypodermatically at 2 p. m. and 4:30 p. m.

Temperature normal the following morning. A typical secondary skin rash present.

Recovery within 10 hours.

(67—1936.) This patient, exposed to infection on December 20, 1935, developed two small lesions on the penis which were positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on January 30, 1936, followed by 0.45 gram injections on January 7 and 14. He was given three injections of bismuth as concurrent treatment.

One hour after the last injection of neoarsphenamine the patient developed nausea, followed by a temperature of 101.2° F., flushed skin, and a typical Herxheimer skin reaction. He was given 1 gram of sodium thiosulphate intravenously.

Recovery within 48 hours.

(68—1936.) After exposure to infection this patient developed a small sore on the penis. He stated that he treated the sore for some time but it would not heal. Examination showed a small ulcer on the penis, generalized lymphadenopathy, and a generalized secondary skin rash. A Kahn blood test was 4-plus.

He was given a 0.25 gram injection of neoarsphenamine on April 21, 1936, and experienced a mild therapeutic shock and a decided flare-up of the rash the following morning. Temperature, 102.2° F.

Recovery within 24 hours.

The patient was given 0.4 gram injections of neoarsphenamine on April 25, 30, and May 7, 1936, without signs or symptoms of further reaction.

(69—1936.) The source of infection in this case is unknown. The patient was given a diagnosis of syphilis because of several lesions in the mouth which were positive for *Treponema pallidum*, general adenopathy, and a healed scar on the penis.

Arsenical treatment began with a 0.34-gram injection of neoarsphenamine August 18, 1936, followed by 0.45-gram injections on August 21 and 25. Twenty hours after the last injection the patient complained of chills and general malaise. Temperature 104° F.; pulse, 140; and respiration, 40.

A slight papular rash appeared over the trunk the following day; subsided within 2 days. Temperature gradually returned to normal.

Recovery in 8 days.

LIVER DAMAGE

(70—1936.) This patient, exposed to infection on November 5, 1935, developed a lesion on the penis which was positive for *Treponema pallidum*. Repeated Kahn blood tests were negative.

Arsenical treatment began with a 0.3-gram injection of neoarsphenamine December 19, 1935, followed by a 0.45-gram injection on December 24, a 0.6-gram injection on December 27, 1935, and a 0.45-gram injection on January 3, 1936. He was given six injections of bismuth salicylate as concurrent treatment.

About 4 hours after the last injection of neorarsphenamine the patient complained of nausea. Temperature 103° F. Several hours later a mild skin rash appeared and the conjunctivae were injected. The following day the conjunctivae continued to show redness, there was slight fever, and a subsidence of the skin rash. He was given 1 gram intravenous injections of sodium thiosulphate on January 4 and 6.

January 15: The skin and conjunctivae show marked increase in jaundice. Red blood count, 3,880,000; white blood count, 8,100; hemoglobin, 85 percent; segments, 61; bands, 4; juveniles, 2; lymphs, 25; eosins, 8. Urinalysis: Color, dark amber; reaction, acid; specific gravity, 1.020; bile, positive, with dilution 1–50; much mucus; many leukocytes; many epithelial cells. Icterus index, 48.

January 23: Icterus index, 37.

January 27: Red blood count, 3,600,000; white blood count, 12,150; hemoglobin, 75 percent; segments, 40; bands, 16; lymphs, 28; eosins, 8; monos, 7; basos, 1. Icterus index, 28. Urinalysis, negative.

February 5: The patient shows rapid improvemnt. Icterus index, 10.

The patient's condition gradually improved and he was returned to duty 50 days after the last injection of neoarsphenamine.

BLOOD DYSCRASIAS

(71—1936.) Two months after exposure to infection this patient developed a lesion on the glans penis which was positive for *Treponema pallidum.*

From March 7 to September 8, 1936, he received 16 injections of neoarsphenamine, a total of 7.5 grams, and 23 injections of bismuth salicylate.

The third course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine December 1, 1936, followed by a 0.45-gram injection on December 16, and 0.5-gram injections on December 22 and 29. Immediately following the last injection the patient became nauseated and dizzy, and there was slight bleeding from the gums. Examination showed a single purpuric spot on the right buccal mucous membrane.

December 30: There are several small purpuric spots in the mucous membrane of the mouth and blood is oozing from the gingival lines. The skin on the internal surface of the thighs and legs bears a mass of purpuric spots which at some points are so close together they form purpuric patches. Red blood count, 4,330,000; white blood count, 9,550; bands, 6; segments, 70; lymphs, 24. He was given 1 gram of sodium thiosulphate intravenously.

December 31: The purpuric spots are fading and the oozing of the blood from the gums has gradually decreased during the past 24 hours. The patient has no complaint.

Recovery in 4 days.

(72—1936.) The source of infection in this case is unknown. The patient was given a diagnosis of syphilis because of a general body rash, inguinal adenopathy, injected pharynx and soft palate, and an indurated ulceration at mucocutaneous border of anus anteriorly. Repeated dark-field examinations of the ulceration were negative for *Treponema pallidum;* Kahn blood test was 4-plus; and a Wassermann test was strongly positive.

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine December 24, 1935, followed by 0.45 gram injections on December 31, 1935, and January 7 and 14, 1936. Four injections of bismuth salicylate were given as concurrent treatment.

About 50 hours after the last injection of neoarsphenamine the patient complained of general malaise and slight chills. Temperature, 99.8° F.

January 17: The patient complains of sore throat. Examination shows some injection of the pharynx and soft palate, infected ingrowing toenail, and lymphangitis of dorsum.

January 18: The patient continues to complain of sore throat and slight chilliness.

January 19: The patient complains of sore and painful gums. Temperature, 102° F. He was given saline mouth washes every 2 hours, and hot baths and hot water bottles to induce sweating.

January 20: The patient's condition is about the same. Laboratory reports revealed absence of granular type cells. He was given 1 gram of sodium thiosulphate intravenously, 3 cubic centimeters of liver extract, Fischer's solution, 500 cubic centimeters by Murphy drip, and 250 cubic centimeters of blood, by direct method.

January 21: Treatment continued as above, including 250 cubic centimeters of blood. The patient's temperature ranges from 100.4° F. in the mornings to 103.6° F. in the afternoons. The gums show ulceration at the margin of the teeth. The soft palate is injected and mildly edematous. The sublingual lymph glands are swollen and tender.

January 22: The patient's condition is about the same. Temperature, 104.2° F. He complains of pains in the teeth and neck. Above treatment continued, except the blood transfusion.

January 23: The patient continues to complain as above. Morning temperature, 102° F. Two ulcerated areas of the hard palate opposite the molars noted. Above treatment continued, including X-ray therapy to the glands of the neck.

January 24: The patient's general condition is about the same. Above treatment continued. A small spot of erythema appears at each point of injection of hypodermic needle. There is an extension of ulceration of the gum on the upper left side into the hard palate.

January 26: The patient's general condition shows improvement. The greater part of the brachial vein is involved.

January 28: The patient shows marked improvement. Semisoft diet. Intake and output satisfactory. Temperature ranges between 98.6° F. and 99.6° F.

February 1: The patient continues to improve. Temperature normal throughout the day. Some residual induration about the left brachial vein. General condition excellent.

Blood

Date	Red cell count	White cell count	Hemoglobin	Bands	Segmented	Lymphocytes	Eosinophiles	Basophiles	Monocytes	Juveniles	Myelocytes	Blast cells	Rieder cells	Turck's cells	Reticulocyte count
January 20, 1936	5,240,000	8,500	90	----	----	14	1	2	83	----	----	----	----	----	----
January 21, 1936	5,450,000	3,500	100	----	----	16	1	----	83	----	----	----	----	----	----
January 23, 1936	4,930,000	2,600	95	----	----	11	1	----	88	----	----	----	----	----	----
January 23, 1936	5,500,000	2,900	100	----	----	19	1	----	80	----	----	----	----	----	----
January 25, 1936	4,680,000	1,700	90	----	----	26	2	----	72	----	----	----	----	----	0.3
January 27, 1936	4,940,000	3,300	95	9	18	22	8	2	33	1	1	4	1	1	----
January 28, 1936	4,400,000	5,000	85	16	22	28	8	----	14	6	6	----	----	----	----
January 29, 1936	4,850,000	6,000	90	10	40	21	3	----	17	6	2	----	1	----	----
February 3, 1936	4,350,000	18,000	90	13	57	14	1	----	2	7	6	----	----	----	----
February 4, 1936	4,550,000	8,200	80	4	64	22	2	----	8	----	----	----	----	----	----
February 29, 1936	4,650,000	6,000	90	8	46	21	8	----	19	----	----	----	----	----	----

The patient's condition gradually improved and he was returned to duty 27 days after onset of the first symptoms.

(73—1936.) After exposure to infection this patient developed a penile lesion which was positive for *Treponema pallidum.* From May 26 to June 16, 1928, he was given two injections of neoarsphenamine (amount not recorded), and daily mercury inunctions.

October 31, 1935: Examination showed a secondary skin eruption and generalized adenopathy. Although the patient presented no primary lesion this was considered to be a reinfection. A Kahn blood test was 4-plus.

From November 2, 1935 to February 5, 1936 he received 16 injections of neoarsphenamine, a total of 9 grams. Twelve injections of bismuth and an unstated amount of mercury inunctions were given as concurrent treatment.

The third course of arsenical treatment began April 14, 1936, with a 0.3 gram injection of neoarsphenamine, followed by 0.6 gram injections on April 21, 28, May 5, 12, 19, 26, June 2, 9, and 16. As concurrent treatment nine injections of bismuth salicylate were given.

Following the last injection of neoarsphenamine the patient complained of headache, dizziness, and general lassitude. Spinal fluid examination was essentially negative.

The patient stated on July 7, 1936 that he was not able to do his work, and became very tired on little effort. Also stated that he often developed headaches in the evenings and had lost weight due to loss of appetite. Physical examination

was negative except for signs and symptoms of severe anemia and marked pallor of the skin and mucous membrane.

Further examination revealed an anemia of the aplastic type with depression of all formed elements of the blood. At intervals there was bleeding from the gums and petechial hemorrhages. There was no pathology of the heart or lungs. Urine examination was negative. In spite of the treatment indicated below there was little improvement in the anemia until about November 11, 1936, when evidence of blood regeneration appeared. This improvement was gradual but continuous and was associated with a complete disappearance of symptoms. At the time of discharge the red blood count was 3,400,000, with 69 percent hemoglobin. Response to exercise was normal and the patient experienced no fatigue. His weight was slightly above the normal level.

The patient was discharged to duty under observation and treatment 165 days after onset of the first symptoms.

Treatment.—Throughout hospitalization the patient received whole liver three times a week with 20 grams of liver extract, equivalent to 200 grams of whole liver daily; ferrous carbonate, 2 grams daily; ultra-violet radiation, three times a week; 15 blood transfusions, a total of 6,440 cubic centimeters of blood; from August 16 to September 3 he received 8 injections of pentnucleotide, 10 cubic centimeters, and 0.5 cubic centimeter of adrenalin twice daily.

Blood

Date	Red cell count	White cell count	Hemoglobin	Bands	Segmented	Lymphocytes	Eosinophiles	Monocytes	Basophiles	Juveniles	Reticulocyte count
July 7, 1936	1,810,000	2,000	60	3	25	69	3	4	------	------	------
July 10, 1936	2,680,000	2,700	75	10	38	45	3	------	------	------	(1)
July 13, 1936	2,350,000	------	70	------	------	------	------	------	------	------	------
Aug. 13, 1936	2,070,000	------	52	------	------	------	------	------	------	------	------
Aug. 21, 1936	1,790,000	2,900	52	9	34	57	------	------	------	------	------
Aug. 28, 1936	1,810,000	1,850	56	19	24	51	1	4	1	------	0.6
Sept. 4, 1936	2,310,000	2,250	56	14	34	51	------	------	------	1	.4
Sept. 11, 1936	2,680,000	2,300	56	5	31	64	------	------	------	------	.4
Sept. 18, 1936	2,160,000	2,800	48	10	40	50	------	------	------	------	.8
Sept. 25, 1936	2,960,000	3,550	54	6	29	60	2	2	------	1	.7
Oct. 2, 1936	1,980,000	1,800	47	4	27	69	------	------	------	------	.5
Oct. 9, 1936	2,180,000	------	51	------	------	------	------	------	------	------	.15
Oct. 16, 1936	2,990,000	------	50	------	------	------	------	------	------	------	.3
Oct. 23, 1936	2,470,000	------	46	------	------	------	------	------	------	------	------
Oct. 30, 1936	2,780,000	------	50	------	------	------	------	------	------	------	------
Nov. 6, 1936	2,700,000	------	49	------	------	------	------	------	------	------	------
Nov. 10, 1936	------	------	------	------	------	------	------	------	------	------	2.5
Nov. 12, 1936	2,560,000	------	55	------	------	------	------	------	------	------	------
Nov. 20, 1936	2,340,000	------	44	------	------	------	------	------	------	------	.9
Nov. 27, 1936	2,880,000	------	64	------	------	------	------	------	------	------	------
Dec. 11, 1936	3,080,000	------	60	------	------	------	------	------	------	------	------
Dec. 18, 1936	3,200,000	------	69	------	------	------	------	------	------	------	------
Jan. 4, 1937	3,400,000	------	66	------	------	------	------	------	------	------	------

1 Blood picture: Red blood count: Anisocytosis, moderate with macrocytes predominating. Poikilocytosis, very mild. Hypochromasia, absent. Other than the above there is no abnormality in the red cells. White blood count: No toxic degeneration. Marked leukopenia, with lymphocytosis and mild eosinophilia. Platelets, decreased.

HEMORRHAGIC ENCEPHALITIS

(74—1936.) After exposure to infection on November 22, 1935, this patient developed a lesion on the glans penis which was positive for *Treponema pallidum.*

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine December 24, 1935, followed by 0.4 gram injections on December 31, 1935, and January 7, 1936, and a 0.45 gram injection on January 15, 1936. He was given 4 injections of bismuth, a total of 0.52 gram, as concurrent treatment.

On January 20, 1936, the patient was admitted to the sick list because his roommates complained that he had been acting peculiarly for 3 days. The patient refused to talk to any one except to say "I am sick." Upon admission the patient looked ill, his eyes were glassy with a staring expression, and his beard showed about 3 days' growth. He stated that he had been sick for 3 days, complaining of pains in the abdomen, vomiting and diarrhea, and had not urinated during this period. Examination revealed a large tumor-like mass in the region of the urinary bladder. He was catheterized and 1,150 cubic centimeters of urine obtained. The tumor-like mass disappeared. The patient was oriented as to place and position but completely disoriented as to time. On further questioning, it was plainly evident that his story could not be relied upon.

January 21: The patient appears somewhat clearer mentally but disoriented as to time. He has vomited about three times since admission, the vomitus consisting of clear undigested food. He was catheterized at 10 p. m. last night and again this morning, after he had made numerous unsuccessful attempts to void. The right nostril is obstructed by nasal secretion and watery pusy secretion, with edema of the mucous membrane and turbinates. The soft palate and pharynx show injection and inflammation with a slight foul odor to the breath.

January 22. The patient complains of headache which prevented his sleeping during the night. Spinal puncture done, prone position; initial pressure 22 millimeters of mercury, with a fall and rise to 34 millimeters of mercury on bilateral jugular pressure. The fluid is clear throughout and possibly 30 to 35 cubic centimeters withdrawn. Spinal fluid cell count, polys, 13; lymphs, 82; monos, 1, and unclassified, 4. The spinal pressure was 6 millimeters of mercury. The patient stated his headache left him after the spinal fluid withdrawal. The impression of this case is that it is possibly a reaction of neoarsphenamine with cerebral edema and meningovascular syphilis involving the basal portion of the brain, as there is a disburbance in the patient's speech and his ability to enunciate clearly. Possibility of brain abscess.

January 23. The patient stated that he feels better than he has for several days. Complains of mild headache, which prevented him from sleeping well. Examination shows injection and edema of both nerve heads with tortuosity of the vessels. The bowels have not been evacuated or the bladder emptied since admission, there being an overflow when the bladder becomes distended. Temperature, normal; pulse, 60.

January 24. The patient had a comfortable night, sleeping most of the time. During the late part of the morning he complained of increasing headache, stating "It is worse than it has ever been before." Temperature 97° F., pulse between 48 and 50; respirations, 16 to 18. There is still present an injection of the mucous membrane of the nasal pharynx and the soft palate with a catarrhal discharge from the posterior pharyngeal wall. The patient is still unable to empty the bladder or bowels voluntarily. Spinal puncture done and 25 to 40 cubic centimeters of clear spinal fluid withdrawn. Initial pressure, 36 millimeters of mercury. Jugular compression of the right side failed to bring about any rise in the mercury column, on the left side the mercury rose 2 millimeters to 40 millimeters. The patient stated that the headache disappeared following the withdrawal of the fluid. Blood pressure, 102/70.

January 27. The patient feels well. He is sleeping satisfactorily and has a good appetite. He was able to empty the bladder last night and this morning.

The patient's condition gradually improved and by February 8 he was able to urinate and control the bowels without difficulty. By February 18 he was up and about, eating and sleeping well, correctly oriented at all times, and has no complaints.

He was returned to duty March 20, 1936, 64 days after onset of the first symptoms.

(75–1936.) This patient was exposed to infection October 26, 1935, and 7 weeks later a lesion appeared on the glans penis. Repeated dark-field examinations of the lesion were negative for *Treponema pallidum.* Kahn blood tests were 4-plus, December 16, 1935, and January 6, 1936. A spinal fluid examination showed 1,174 cells and gold curve, 1222222343.

Arsenical treatment was instituted January 8, 1936, with a 0.3-gram injection of neoarsphenamine, followed by a 0.3-gram injection on January 10, and a 0.6-gram injection on January 17. Four intramuscular injections of bismuth salicylate were given as concurrent treatment.

Approximately 56 hours after the last injection of neoarsphenamine the patient complained of slight headache and nausea. Temperature of 100° F.

January 19: The patient felt better at morning sick call. Headache and nausea had subsided. Temperature, 99.2° F. Several hours later the patient appeared to be disoriented and restless. His temperature rose to 101° F. at noon and returned to normal within 6 hours. The patient was seen by the medical officer of the day at 10 p. m., and he appeared quiet and comfortable. He had no complaint and slept through the night.

January 20. At 8:30 a. m. the patient was semiconscious, did not understand or answer questions, and could not be aroused. Examination showed: Heart sounds, normal; blood pressure, 130/78; lung sounds, negative; pupils, dilated; Babinski, Kernig's, ankle clonus, and knee jerks, negative; and biceps reaction, positive. Spinal puncture shows clear fluid, not under pressure, dripping very slowly, and about 10 cubic centimeters drained. Patient's unconsciousness became gradually more profound. During the morning he appeared better after the injection of epinephrine hydrochloride, and the pulse and blood pressure were good.

Urinalysis: Color, amber; reaction, acid; specific gravity, 1.024; albumin, 2 plus; few fine granular casts; few cylindroids; few leukocytes; few epithelium. Autenrieth's test, negative.

Blood: 11 a. m.—Red blood count, 4,500,000; white blood count, 4,800; hemoglobin, 90 percent; monos, 2; lymphs, 12; segments, 68; bands, 18; platelets, 160,000.

1 p. m.—Red blood count, 4,610,000; white blood count, 22,500; hemoglobin, 90 percent; lymphs 7; segments, 73; bands, 17; juveniles, 3; platelets, 170,000.

7 p. m.—Red blood count, 4,200,000; white blood count, 17,200; hemoglobin, 80 percent; segments, 72; lymphs, 9; bands, 19.

During the afternoon the blood pressure dropped steadily. He was unconscious and the lower limbs paralyzed. At 6 p. m. breathing was of the Cheyne-Stokes type, the pulse weaker and more rapid.

Treatment given January 20, 1936:

9 a. m.—Epinephrine hydrochloride, 1–1000 solution, 1 cubic centimeter subcutaneously. Two ounces of magnesium sulphate by mouth.

9:30 a. m.—One gram of sodium thiosulphate intravenously.

11 a. m.—Epinephrine hydrochloride, 1–1000 solution, 1 cubic centimeter subcutaneously. Two ounces of magnesium sulphate by mouth.

11:30 a. m.—Twenty cubic centimeters of 50 percent glucose intravenously.

1 p. m.—Epinephrine hydrochloride, 1–1000 solution, 1 cubic centimeter subcutaneously.

2 p. m.—Epinephrine hydrochloride, 1–1000 solution, 0.5 cubic centimeter subcutaneously.

3 p. m.—Epinephrine hydrochloride, 1–1000 solution, 0.5 cubic centimeter subcutaneously. Fischer's solution, 125 cubic centimeters by proctoclysis, at the rate of 30 drops per minute.

4 p. m.—Epinephrine hydrochloride, 1–1000 solution, 1 cubic centimeter subcutaneously.

6 p. m.—Epinephrine hydrochloride, 1–1000 solution 1 cubic centimeter subcutaneously.

8 p. m.—Twenty cubic centimeters of 50 percent glucose intravenously. Epinephrine hydrochloride, 1–1000 solution, 1 cubic centimeter subcutaneously.

9 p. m.—Fischer's solution, 125 cubic centimeters by proctoclysis, at the rate of 30 drops per minute.

9:30 p. m.—Epinephrine hydrochloride, 1–1000 solution, 1 cubic centimeter subcutaneously.

11:30 p. m.—Epinephrine hydrochloride, 1–1000 solution, 1 cubic centimeter subcutaneously.

The patient died at 12:25 a. m., January 21, 1936, within 4 days after the last injection of neoarsphenamine.

Autopsy findings: (1) Acute hemorrhagic encephalitis. (2) Acute congestion of all viscera.

Tryparsamide.—(76—1936.) This patient (supernumerary, retired, U. S. Navy) was given a diagnosis of syphilis because of clinical and serological findings. The patient stated he was probably infected in 1920.

From March 25 to April 29, 1935, he received 12 injections of bismuth salicylate; from May 2 to July 2, 1935, 8 injections of neoarsphenamine, a total of 4.2 grams; and from July 16 to November 12, 1935, 16 injections of bismuth salicylate.

He complained of vomiting when he was admitted to the sick list on December 20, 1935, stating that the vomiting occurs early in the morning and is followed by four or five retching spells. Physical examination essentially negative. The patient was kept under observation and treatment.

He was given 1.5 grams of tryparsamide on December 27, 1935, and 3 grams on January 7. Six days after the last injection of tryparsamide the patient stated that he could not see and read well. Eye examination—Vision: O. D. 20/40 − 1, J 14; O. S. 20/50 + 4, J 18. Ophthalmoscopic examination shows vitreous humor clear, except for round floating vitreous opacity in left eye, and disks paler than normal. Fields for form decreased concentrically 4/8. It is believed that the color of disk may be accounted for in part by the age of the patient and some loss of field by ametropia.

January 27. Vision: O. D. 20/50 − 1, J 14; O. S. 20/70, J 16. Visions and fields continue to decrease. No change in fundus picture.

February 11. Fields for form V. O. D. has increased approximately one-third over last report; V. O. S. approximately the same size.

March 2. The vision about the same. The patient is up and about the ward. He can read newspaper captions but not the ordinary print.

March 17. The fields for form V. O. D. has increasedly markedly over the last report, within 20° circle and V. O. S. increased with 30° circle.

March 27. Vision: O. D. 20/50 + 4; O. S. 20/70—1. The fields are virtually stationary. It is considered that further diminution will probably not take place or that improvement will progress further. He has received 20 injections of bismuth salicylate, 2 grains each, between December 31, 1935, and April 21, 1936.

The patient was transferred to the Naval Home, Philadelphia, Pa., 78 days after the onset of the first symptoms, with diagnosis "optic neuritis, from tryparsamide, condition stationary."

ANTITETANUS TOXOID

By O. S. Stephenson, Commander, Medical Corps, United States Navy and W. W. Hall, Commander, Medical Corps, United States Navy

Active immunity in man animal against tetanus can be developed by the injection of tetanus toxoid as demonstrated a few years ago by Ramon of the Pasteur Institute Ramon had developed diphtheria

toxoid and later the refined alum-precipitated diphtheria toxoid was developed, now so universally used in immunization of children against diphtheria.

Evidence from both animal and human immunization with alum-precipitated tetanus toxoid (quite analogous to that of diphtheria) indicates that a satisfactory active immunity can be developed against tetanus by two injections 8 weeks apart. The immunity thus produced diminishes gradually but persists at a satisfactory protective level for at least 2 years and probably much longer.

In handling wounded patients who have been previously immunized against tetanus by toxoid injections, it is now recommended that they be given a stimulating or "pick-up" injection of alum-precipitated tetanus toxoid in case there is any doubt about the immunity level. Immunized individuals even those with very low antitoxin titers, respond to a secondary immunization by a sharp rise to high levels within a week. This sharp rise on secondary stimulation means ample protection against possible tetanus at the time, and a higher level of immunity for the future. Possibly, lifetime immunity may result after two or more "pick-up" shots.

Work which supports the above has been published by Ramon (France), Sneath and Kerslake (Canada), Bergey and Etris (United States), Hall (U. S. Navy), and more recently Leach, Zia, and Lim (China).

Tetanus toxoid is thermostable—not deteriorating when exposed to heat, as for example with expeditionary forces. Tetanus toxoid is serum free, not producing reactions, anaphylaxis, or serum sickness.

As there is no simple means of estimating immunity against tetanus such as the Schick test in diphtheria, patients must be bled and the serum titrated for antitoxic strength by the protection it affords test animals against known amounts of tetanus toxin. Because of these difficulties, the data from work with man is accumulating slowly, though much animal experimental data are available.

Mass-immunization and data on tetanus incidence in the protected group, compared with unprotected groups, will be convincing. Such work is now in progress in the United States. In France this method of immunization against tetanus has, by recent legislation, been made mandatory in the Army for men and animals. Accurate data obtainable only by animal titration of serum antitoxin are needed and can only be accumulated by the efforts of many laboratories.

The Medical Department, United States Naval Academy, and the Naval Medical School are now cooperating in the study of a group of 137 volunteers, including the football squad at the Academy who were immunized early this year by two injections of alum-precipitated tetanus toxoid.

FOOD POISONING ON BOARD THE U. S. S. "NEVADA"

The outbreak occurred among the enlisted personnel on June 26, 1937, and involved 131 men. All men reporting and those found sick about the ship were treated, admitted to the sick list, and put to bed in the ward and adjoining compartments assigned for the purpose.

From those affected it was found that the first symptoms, consisting of nausea and mild abdominal cramps, began approximately 2 hours after eating the noon meal. The symptoms gradually became more severe, until at the end of 3 hours most of the men began vomiting and complained of severe abdominal cramps. Four of the men were unconscious when brought to the sick bay and one of these four had not vomited, 7 hours after eating. His entire body was rigid and at intervals respiration would cease for an alarming period of time. His pupillary reflexes were present and the pulse was of normal rate, full and regular. Following the induction of emesis he responded to the routine treatment. Hysteria was considered a factor in this case. All of the first vomitus consisted of ham and other articles of food from the noon meal. In some cases after the food had been ejected, retching would continue and some bloody material was vomited.

The usual symptomatic treatment was instituted and response in all cases was satisfactory. On June 28, the second day after the outbreak, all patients were examined and it was necessary to retain only one man on the sick list. He was discharged to duty the following day.

The following menu was served for noon meal on June 26. Opposite each item on the menu is indicated the number of men eating that article of food, who became ill:

Bean soup	46	Turnips	17
Boiled ham	131	Potatoes	71
Boiled cabbage	59	Pickles	70
Carrots and peas	52	Bread, butter, and coffee	99

It will be observed that 131 men became ill, all of whom ate ham. Ten of these men ate only ham sandwiches and did not partake of anything else served. All messes except the chief petty officers' were involved, from 1 to 15 men per mess becoming ill.

A total of 636 men were on board for the noon meal, 505 of whom suffered no ill effects. The men who did not become ill partook of the foods on the menu to the same extent as those who did become ill. This is indicated by the following summary:

Bean soup	180	Turnips	150
Boiled ham	476	Potatoes	399
Boiled cabbage	256	Pickles	452
Carrots and peas	238	Bread, butter, and coffee	476

Forty-two hams were boiled Thursday afternoon, June 24, and cold water poured over them to cool them off. One hour later the water was drained off and the hams left until 4 a. m., June 25, at which

time they were removed to steep tubs. Between 10 and 11 a. m. they were skinned and boned and four of the hams given to the chief petty officers' cook. The tubs of hams were left on the galley deck until field-day was completed. At 4:30 p. m. the hams were put in a cool oven where they remained until about 11 a. m. the next day, at which time they were removed, sliced, and issued to the various mess cooks for the noon meal.

From the foregoing it is obvious that the ham was responsible for the outbreak. The ship's cook who boned the hams was found upon examination to be a carrier of the organisms of food poisoning group (staphylococcus albus-poisoning strain). Bacteriological examination of specimens obtained from cooked hams from the same lot served for the meal in question showed no contamination by organisms of the food-poisoning group.

The opinion of a board appointed to investigate this outbreak was: "That during the process of skinning and boning on June 25, 1937, the hams which had been cooked on June 24, 1937 became contaminated."

24140—37——11

STATISTICS

HEALTH OF THE NAVY

The following tables are summaries of morbidity rates per 1,000 for the second quarter of 1937 in comparison with rates for the corresponding quarter of the preceding 5 years:

Entire Navy

Year	All diseases	Injuries	Poisonings	All causes	Communicable diseases		Venereal diseases
					A	B	
1932	470	51	0.33	521	(1)	(1)	141
1933	407	62	1.51	470	18	75	100
1934	385	67	.45	452	35	116	64
1935	371	65	1.88	438	28	85	62
1936	337	49	.07	386	30	140	42
1937	276	36	.31	313	18	98	59
FORCES ASHORE							
1932	542	44	0.31	586	(1)	(1)	92
1933	486	78	.91	565	23	96	79
1934	621	87	1.15	709	76	230	58
1935	491	78	1.53	571	54	110	45
1936	518	50	.09	568	59	226	26
1937	312	35	.50	347	34	131	27
FORCES AFLOAT							
1932	431	54	0.34	486	(1)	(1)	168
1933	369	54	1.80	424	16	64	111
1934	271	57	.11	328	15	62	67
1935	312	58	2.06	372	16	72	71
1936	229	49	.05	278	13	89	51
1937	256	37	.20	293	8	78	78

[1] Not available.

Common infectious diseases of the respiratory type.—A total of 2,617 admissions for these diseases were reported from the entire Navy during the second quarter of the year 1937, or a 68-percent decrease from the number of cases notified for the preceding quarter. Catarrhal fever was responsible for 1,645 of the total admissions for these diseases.

Ships and shore stations reporting the largest number of cases were as follows:

	April	May	June	Total
Naval Training Station, Newport, R. I.	71	86	105	262
Naval Training Station, San Diego, Calif.	90	67	83	240
Naval Training Station, Norfolk Va.	89	48	57	194
Marine Corps Base, San Diego, Calif.	23	35	21	79
U. S. S. *Oklahoma*	17	27	9	53
Naval Training Station, Great Lakes, Ill.	22	14	12	48
Naval Academy, Annapolis, Md. (other than midshipmen)	23	13	11	47
Fourth Marines, Shanghai, China	20	13	13	46
Naval Air Station, Pensacola, Fla.	30	7	8	45
Naval Air Station. Norfolk, Va.	12	15	15	42
Marine Barracks, Quantico, Va.	19	8	10	37
U. S. S. *Tennessee*	11	14	10	35
Marine Detachment, Peiping, China	13	10	12	35
U. S. S. *Lexington*	17	15	3	36

Of the 2,617 admissions for the entire Navy, 1,401 admissions were reported by forces ashore and 1,216 for forces afloat.

Influenza was the cause of two deaths, complicated in one instance by pneumonia, broncho (U. S. Naval Hospital, Chelsea, Mass.), and in the other by meningitis, cerebrospinal, acute (U. S. S. *Tennessee*). Tonsillitis, acute, was recorded as the primary cause of one death, the contributory cause being abscess, lung.

Several rather severe cases of gastrointestinal influenza occurred during the month of June at the Navy Yard, Charleston, S. C.

The medical officer of the United States Naval Training Station, San Diego, Calif., comments as follows in the sanitary report for June 1937:

> The health of the personnel during the month of June has been good. Although the personnel has been increased approximately 20 percent over the previous 2 years the acute respiratory infections (bronchitis, acute) which required hospitalization has increased approximately 60 percent. This is attributed to the more severe type of respiratory infections over the previous 2 years and to the climatic conditions.

Cerebrospinal fever.—Seven cases of cerebrospinal fever were reported in April, May, and June 1937, as follows:

Rate	Age	Place of original admission	Date of admission	Length of service	Disposition
				Yrs. Mos.	
Seaman, first-class	21	U. S. S. *Nevada*	Apr. 7, 1937	1 6	Duty, June 22, 1937.
Seaman, first-class	24	U. S. S. *Nevada*	do	5 7	Duty, June 4, 1937.
Private	24	U. S. S. *Chaumont*	May 13, 1937	2 3	Duty, July 17, 1937.
Seaman, first-class	26	U. S. S. *Ranger*	do	7 6	Duty, June 28, 1937.
Seaman, second-class	20	U. S. S. *Trenton*	May 12, 1937	0 6	Duty, July 26, 1937.
Seaman, first-class	20	U. S. S. *Dobbin*	June 14, 1937	2 7	Duty, Sept. 14, 1937.
Seaman, first-class	21	U. S. S. *Pope*	June 8, 1937	1 6	Duty, July 8, 1937.

Mumps.—One hundred and sixty-six cases of mumps were reported for the quarter. The United States naval training station, Norfolk, Va., reported 28 cases in April, 34 in May, and 21 in June; the U. S. S. *West Virginia*, 13 in May and 16 in June; the Marine detachment, Peiping, China, 16 in April and 1 in May; the Submarine Base, New London, 11; the Marine Barracks, Quantico, Va., 6; the naval training station, San Diego, Calif., 3; the naval training station, Great Lakes, Ill., naval air station, San Diego, Calif., naval air station, Seattle, Wash., and the fleet air base, Pearl Harbor, Territory of Hawaii, 2 each; and 1 each from 9 shore stations.

The Sanitary Report for the month of April from the United States naval training station, Norfolk, Va., stated that "mumps, which has been highly prevalent in the population of Norfolk, increased and affected widely scattered units."

German measles.—The Fourth Marines, Shanghai, China, reported eight cases of German measles in April and two in May; and the naval training station, San Diego, Calif., two in May.

Scarlet fever.—One case of scarlet fever was reported from the third naval district headquarters, New York, N. Y., in April, and one each from the Receiving Ship, San Diego, Calif., and the Marine detachment Peiping, China, in May.

Chickenpox.—Ten cases of chickenpox were reported for the quarter as follows: In April, one each from the Marine Corps base, San Diego, Calif., Navy Yard, Mare Island, Calif., and the Marine detachment, Peiping, China; in May, one each from the Naval Research Laboratory, Anacostia, D. C., United States Naval Academy, Annapolis, Md. (other than midshipmen), Receiving Ship, New York, N. Y., naval training station, Great Lakes, Ill., naval training station, San Diego, Calif., and the U. S. S. *Argonne;* and in June, one from the Navy Yard, Washington, D. C.

Typhoid fever.—A fireman, third-class, 23 years of age, with 8 months' service, was admitted on June 2, 1937, to the U. S. S. *Ranger* with diagnosis "Undetermined (typhoid fever)." The patient was transferred to the United States Naval Hospital, San Diego, Calif., on June 11, where the diagnosis of typhoid fever was established and he was discharged to duty on August 31, 1937. Probable place of infection was Honolulu, Territory of Hawaii. One course of typhoid prophylaxis had been completed November 2, 1936.

Malaria.—The general health conditions of the Submarine Base, Coco Solo, Canal Zone, during the month of June 1937, were satisfactory, except for malaria. The rainfall for this month has been exceeded in amount in only 1 year in the past 30. The Senior Medical Officer reports:

Eleven cases of malaria were placed under treatment for the month of June, nine from this base and two from the U. S. S. *Hannibal.* During the corresponding month in 1936 there were 2 cases from shore activities on this side of the Canal, but no cases from the U. S. S. *Hannibal* or U. S. S. *Nokomis.* There were no relapses during the month. It would appear that the outlook regarding admissions for malaria during the coming months is bad.

The station medical officer of the United States naval station, Olongapo, P. I., reports:

Twelve cases of malaria treated at the Camilla Simpson Hospital during the month. Of these six can trace their infections to towns in the northern part of the Province, where they have been employed in mines and in lumber camps. Five of the cases apparently received their infections in the heavily wooded outlying barrios, which afford a harborage of mosquitoes close to the dwellings.. In one case the source of infection cannot be traced.

Venereal diseases.—The medical bulletin of the Battle Force for the month of July 1937 announces:

That the venereal rate in ships of the Battle Force is steadily declining. The annual rate per 1,000 for the calendar years 1934, 1935, and 1936 was 111, 92, and 58, respectively. For the first half of 1937 the rate shows a slight decrease

over that of 1936, and it is hoped that the second half of the year will show an even greater reduction. The following data for the first half of 1937 are submitted:

(a) Annual rate per 1,000 for all venereal diseases for entire Battle Force for the period January 1 to June 30, 1937, inclusive, was 49 as compared with 58 for 1936.

(b) Monthly average number of gonorrheal infections for the entire Battle Force during the first 6 months of 1937 was 100.6 as compared with 118.8 for 1936.

(c) The highest total number of admissions for gonorrheal infections during any one month was 128. There were 2 months in which this high rate occurred, namely, January and June.

(d) Thirty-five admissions represented the lowest total for any one month; this was during the month of May 1937.

The following table of statistical data for battleships and larger vessels of the Battle Force indicates the frequency of occurrence of venereal diseases during the second quarter of 1937, as reported in monthly reports of communicable diseases received in the Bureau:

Ship	Annual admission rate per 1,000, 2d quarter, 1937	Annual admission rate per 1,000, 2d quarter, 1936	Weighted average per 1,000, 2d quarter, 1933–36
Arizona	63. 18	43. 58	84. 55
California	58. 95	84. 42	105. 15
Cincinnati	0	78. 77	71. 17
Colorado	83. 93	61. 67	123. 63
Concord	44. 77	38. 91	90. 87
Idaho	57. 22	91. 21	104. 99
Marblehead	74. 07	112. 31	120. 69
Maryland	38. 38	53. 79	99. 85
Memphis	112. 56	291. 73	154. 40
Milwaukee	52. 17	54. 17	79. 74
Mississippi	79. 30	54. 69	107. 98
Nevada	17. 11	43. 16	79. 90
New Mexico	71. 30	56. 48	89. 18
Oklahoma	63. 94	76. 85	95. 05
Omaha	168. 19	92. 82	82. 19
Pennsylvania	30. 88	41. 33	81. 74
Richmond	72. 58	60. 34	176. 47
Tennessee	78. 18	60. 05	92. 15
Trenton	96. 38	101. 75	135. 73
West Virginia	59. 18	58. 97	88. 76

Food poisoning.—In the monthly sanitary report for June 1937, the post surgeon of the Marine Barracks, Quantico, Va. reported:

On June 28, seventy-seven men were brought to sick quarters from F. M. C. R. camp suffering from abdominal cramps, nausea, and diarrhea; many vomited. All returned to duty next morning save three, two of whom had three sick days and one of whom had four sick days. Staphylococci alba were cultured from stomach contents, feces, and from minced ham used in sandwiches, of which all had eaten about 12:30 p. m. on June 28.

INJURIES AND POISONINGS

Admissions for Second Quarter Ending June 30, 1937

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the second quarter, 1937, is based upon all Form F cards covering admissions in those months which have reached the Bureau:

	Admissions, April, May, and June, 1937	Admission rate per 100,000 per annum	Admission rate per 100,000, year 1937
INJURIES			
Connected with work or drill	520	1,610	2,513
Occurring within command but not associated with work	398	1,232	1,924
Incurred on leave or liberty or while absent without leave	257	796	1,760
All injuries	1,175	3,638	6,197
POISONINGS			
Industrial poisoning	4	12	7
Occurring within command but not connected with work	5	16	211
Associated with leave, liberty, or absence without leave	1	3	18
Poisonings, all forms	10	31	236
Total injuries and poisonings	1,185	3,669	6,434

Percentage relationships

	Occurring within command				Occurring outside command—leave, liberty, or A. W. O. L.	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty			
	April, May, and June 1937	Year 1936	April, May and June 1937	Year 1936	April, May, and June 1937	Year 1936
Percent of all injuries	44.2	40.6	33.9	31.0	21.9	28.4
Percent of all poisonings	40.0	3.0	50.0	89.5	10.0	7.5
Percent of total admissions, injury and poisoning titles	44.2	39.2	34.0	33.2	21.8	27.6

NOTE.—Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction" or "Alcoholism," as the case may be. Such cases are not included in the above figures.

Three members of service personnel sustained injuries when the German airship *Hindenburg* burned at the naval air station, Lakehurst, N. J., on May 6, 1937.

MORBIDITY

SUMMARY FOR THE SECOND QUARTER ENDING JUNE 30, 1937.

Average strength	Forces afloat, 81,417		Forces ashore, 47,781		Entire navy, 129,198	
	Admissions	Rate per 1,000	Admissions	Rate per 1,000	Admissions	Rate per 1,000
All causes	5,967	293.16	4,140	346.58	10,107	312.92
Disease only	5,201	255.52	3,721	311.50	8,922	276.23
Injuries	762	37.44	413	34.57	1,175	36.38
Poisonings	4	.20	6	.50	10	.31
Communicable diseases transmissible by oral and nasal discharges (class VIII):						
(A)	166	8.16	404	33.82	570	17.65
(B)	1,596	78.41	1,560	130.60	3,156	97.71
Venereal diseases	1,584	77.82	317	26.54	1,901	58.86

DEATHS

During the Second Quarter Ending June 30, 1937

Cause		Navy			Marine Corps		Nurse Corps	Total
Primary	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
DISEASE								
Average strength		9,670	1,994	99,080	1,304	16,754	396	129,198
Abscess, brain	None			1				1
Abscess, subphrenic	Pleurisy, suppurative			2				2
Aerogenous capsulatus infection, thigh.	None			1				1
Calculus, ureteral	Septicemia		1					1
Carcinoma, colon	None	1						1
Carcinoma, duodenum	do			1				1
Carcinoma, liver	do			1				1
Endocarditis, acute ulcerative (malignant).	Arthritis, acute, wrist and phalangeal.			1				1
Furunculosis	Septicemia			1				1
Gonococcus infection, urethra.	Endocarditis, acute ulcerative (malignant).			1				1
Heart block	None	1						1
Hemorrhage, cerebral	Arterial hypertension			1				1
Hyperthyroidism	None			1				1
Influenza	Pneumonia, broncho			2				2
Do	Meningitis, cerebrospinal, acute.			1				1
Leukemia	None			1				1
Otitis, media, acute	Meningitis, cerebrospinal, acute.					1		1
Nephritis, chronic	None				1			1
Do	Arterial hypertension			1				1
Pancreatitis, acute, hemorrhagic.	None					1		1
Pneumonia, lobar	do			5		2		7
Do	Abscess, lung			1				1
Do	Pleurisy, serofibrinous			1				1
Do	Pleurisy, suppurative			1				1
Sarcoma, lung	None			1			1	2
Sarcoma, pubis and ischium	do			1				1
Thrombosis, cavernous sinus	Abscess, face			1				1
Do	Otitis, media, acute			1				1
Do	Tonsillitis, chronic					1		1
Thrombosis, coronary artery	None	2		3				5
Do	Myocarditis, chronic					1		1
Tonsillitis, acute	Abscess, lungs			1				1
Tuberculosis, pulmonary, chronic, active.	Tuberculosis, peritoneum.			1				1
Ulcer, duodenum	Hemorrhage, duodenum	1						1
Do	Hemorrhage, intestines	1						1
Do	Peritonitis, general, acute.	1						1
Do	Pleurisy, suppurative				1			1
Valvular heart disease, combined lesions, aortic and mitral.	None			1				1
Total for disease		7	1	34	2	6	1	51
INJURIES AND POISONINGS								
Crush, chest	None			1				1
Crush, head	do			1				1
Drowning	do	4		11				15
Fracture, compound, skull	do			2		1		3
Do	Meningitis, cerebrospinal, acute.			1				1
Fracture, compound, temporal.	None			1				1
Fracture, simple, temporal	Hemorrhage, traumatic, intracranial.			1				1
Fracture, simple, skull	Edema, lung	1						1
Do	Intracranial injury			2				2
Do	Rupture, traumatic, lung.			1				1

DEATHS DURING THE SECOND QUARTER ENDING JUNE 30, 1937—Continued

Cause: Primary	Cause: Secondary or contributory	Navy: Officers men	Navy: Midship-	Navy: Men	Marine Corps: Officers	Marine Corps: Men	Nurse Corps	Total
INJURIES AND POISONINGS—continued								
Fracture, simple, vertebrae, cervical.	None			1				1
Injuries, multiple, extreme	do	1		4	1	3		9
Strangulation, neck	do	1		1		1		3
Do	Psychoneurosis, unclassified.	1						1
Wound, gunshot, abdomen	None					1		1
Wound, gunshot, chest	do	1				1		2
Wound, gunshot, head	do	1		1		1		3
Wound, gunshot, heart	do			1				1
Poisoning, acute, carbon monoxide.	do			2				2
Total for injuries and poisonings.		10		31	1	8		50
Grand total		17	1	65	3	14	1	101
Annual death rate per 1,000:								
All causes		7.03	2.01	2.62	9.20	3.34	10.10	3.13
Disease only		2.90	2.01	1.37	6.13	1.43	10.10	1.58
Drowning		1.65		.44				.46
Poisonings				.08				.06
Other injuries		2.48		.73	3.07	1.91		1.02

MENTAL AND PHYSICAL QUALIFICATION OF RECRUITS

STATISTICS FOR SECOND QUARTER ENDING JUNE 30, 1937

The following statistics were taken from sanitary reports submitted by naval training stations:

April, May, and June, 1937	United States naval training station—Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	1,421	754	810	1,471
Recruits appearing before Board of Medical Survey	1	0	9	0
Recruits recommended for discharge from the service	1	0	9	0
Recruits discharged by reason of medical survey	3	0	0	0
Recruits held over pending further observation	0	0	0	0
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	0	18	84	74

The following table was prepared from reports of medical surveys in which disabilities or disease causing the surveys were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Absence, acquired, teeth	5	Malformation, congenital, left kidney	1
Acne, vulgaris	2	Malocclusion, teeth	2
Amblyopia, both eyes	1	Mental deficiency, moron	2
Arterial hypertension	1	Metatarsalgia	4
Arthritis, chronic	3	Migraine	1
Asthma	1	Myopia	2
Astigmatism	1	Myositis, chronic	1
Cardiac disorder, functional	1	Nephroptosis	1
Caries, teeth	3	Narcolepsy	2
Chorea, progressive, chronic	1	Otitis, media, chronic	11
Color blindness	2	Pes cavus	1
Congenital heart disease	1	Prostatitis, chronic (nonvenereal)	1
Constitutional psychopathic inferiority, without psychosis	4	Psychoneurosis, hysteria	3
Constitutional psychopathic state, emotional instability	1	Psychoneurosis, neurasthenia	2
Curvature, spine	1	Psychoneurosis, psychasthenia	1
Deafness, bilateral	2	Pyelitis, chronic, left	1
Deafness, unilateral	1	Somnambulism	2
Deformity, acquired, left leg	1	Sprain, sacroiliac joint	1
Dementia praecox	2	Stammering	1
Effort syndrome	1	Strabismus	1
Enuresis	17	Syphilis	1
Epilepsy	5	Tic	1
Flat foot	19	Union of fracture, faulty	1
Gastroptosis	1	Urethritis, chronic (nonvenereal)	1
Gonococcus infection, epididymis	1	Valvular heart disease, combined lesions, aortic and mitral	3
Gonococcus infection, urethra	1	Valvular heart disease, mitral insufficiency	1
Hernia, inguinal	2	Valvular heart disease, mitral stenosis	6
Hernia, inguinal, recurrent after operation	1	Varicocele	1
Hydrocele, spermatic cord	2	Vincent's infection, oral	1
Malformation, congenital, cervical rib	1	Wart	1

VOLUME XXXVI APRIL 1938 NUMBER 2

United States Naval Medical Bulletin

PUBLISHED *for the* INFORMATION OF THE MEDICAL DEPARTMENT *of the* NAVY

DEPARTMENT OF THE NAVY · MEDICINE & SURGERY

THE MISSION OF THE MEDICAL CORPS OF THE NAVY

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TO KEEP AS MANY MEN AT AS MANY GUNS AS MANY DAYS AS POSSIBLE

Issued Quarterly by the Bureau of Medicine and Surgery
Washington, D. C.

VOL. XXXVI APRIL 1938 No. 2

UNITED STATES NAVAL MEDICAL BULLETIN

PUBLISHED QUARTERLY FOR THE INFORMATION OF THE MEDICAL DEPARTMENT OF THE NAVY

Issued by

DIVISION OF PUBLICATIONS
THE BUREAU OF MEDICINE AND SURGERY
NAVY DEPARTMENT

Compiled and published under the authority of Naval Appropriation Act for 1937-38, approved April 27, 1937

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON: 1938

For sale by the Superintendent of Documents, Washington, D. C. - - - - - See page II for price

NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

Owing to exhaustion of certain numbers of the BULLETIN and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:

Volume IX, 1915, No. 1.
Volume X, 1916, No. 2.
Volume XI, 1917, No. 3.
Volume XII, 1918, Nos. 1 and 3.
Volume XXIV, 1926, Nos. 1 and 4.
Volume XXV, 1927, No. 1.
Volume XXVII, 1929, Nos. 3 and 4.
Volume XXVIII, 1930, No. 3.
Volume XXXIV, 1936, Nos. 1, 2, and 4.
Volume XXXV, 1937, No. 1.

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Exchange of publications will be extended to medical scientific organizations, societies, laboratories, and journals. Communications on this subject should be addressed to the Surgeon General, United States Navy, Washington, D. C.

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PREFACE

The United States Naval Medical Bulletin was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, and reports from various sources, notes, and comments on topics of medical interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the Bulletin of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

P. S. Rossiter,
Surgeon General, United States Navy.

NOTICE TO SERVICE CONTRIBUTORS

Contributions to the BULLETIN should be typewritten, *double spaced*, on plain paper, and should have wide margins. Fasteners which will not tear the paper when removed should be used. Nothing should be written in the manuscript which is not intended for publication. For example, addresses, dates, etc., not a part of the article, require deletion by the editor. The BULLETIN endeavors to follow a uniform style in heading and captions, and the editor can be spared much time and trouble, and unnecessary changes in manuscript can be obviated if authors will follow in these particulars the practice of recent issues.

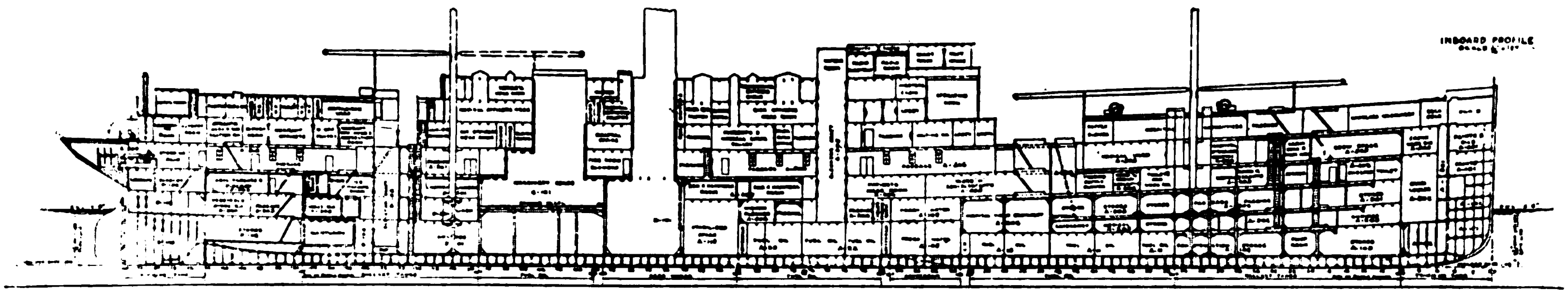
The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received at least 3 months prior to the date of the issue for which they are intended.

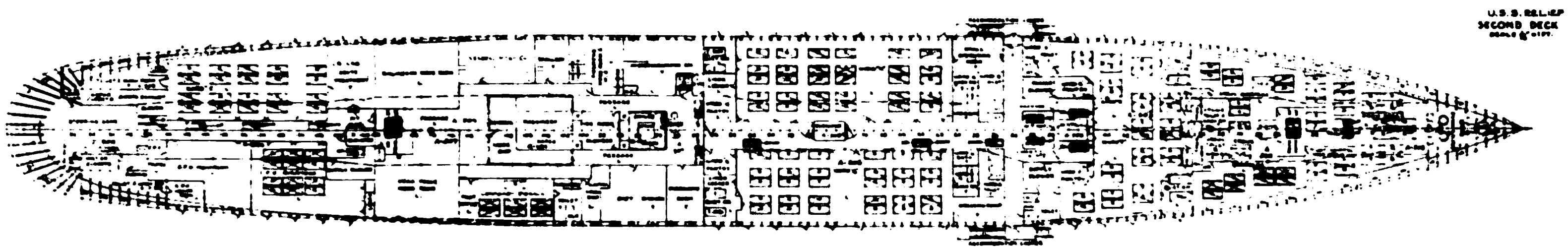
The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized.

The BULLETIN intends to print *only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.*

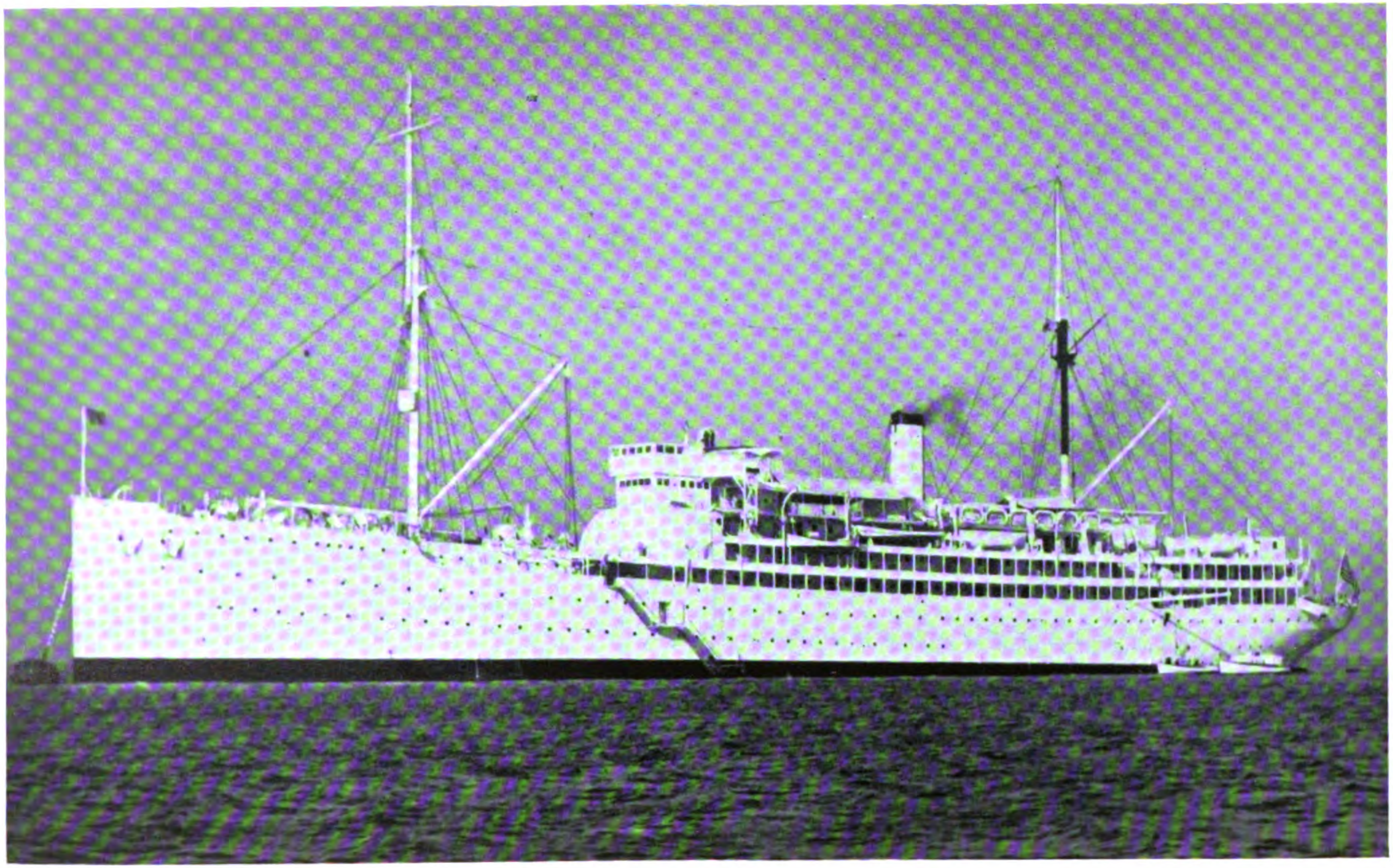
EBEN E. SMITH, *Editor,*
Commander, Medical Corps, United States Navy.



Inboard Profile U. S. S. RELIEF.



Second Deck U. S. S. RELIEF.



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U. S. NAVAL MEDICAL BULLETIN

VOL. XXXVI APRIL 1938 No. 2

SPECIAL ARTICLES

LOGISTICS

INTERRELATION OF THE MEDICAL SERVICE ABOARD SHIP AND TACTICS[1]

By Rear Admiral PERCEVAL S. ROSSITER, Surgeon General, United States Navy

There can be no logistics if we do not have trained personnel to develop them. A perfect system of logistics for mobilization of personnel and material and for our casualty evacuation is impotent without professionally competent personnel to apply them. Hence, in developing its logistic policy the Medical Department of the Navy places primary emphasis and dependence upon officers skilled in their profession. Applicants for commission are carefully chosen. Members of the corps after indoctrination, primarily as naval medical officers, are encouraged to advance themselves professionally in their chosen medical specialties. This is necessary because we must man ships and dispensaries and hospitals continually and we endeavor to do a high class of work.

However, great as is the contribution of our Navy to national life in peace time, we must never lose sight of its primary objective to successfully execute national policy in case of war. When a national emergency develops, our armed forces serve as a nucleus around which a much larger number of reserves and civilians may crystallize. It, therefore, behooves the regular service officer, particularly in the latter half of his career, to obtain a well-grounded experience in military medicine. He must be prepared, should war come, to surrender his purely professional detail to a readily available, equally competent specialist of the reserve and assume duties requiring long, well-grounded military experience.

Since the World War the Navy has developed a well-organized reserve. This reserve includes medical officers, some of considerable service experience, who would be immediately available in case of a national emergency. Organization of these reserves by naval districts facilitates a peace-time training program and simplifies mobilization. Many of these officers have had active duty training with regular and reserve forces. Our service anticipates no difficulty in obtaining sufficient medical officers during a national emergency.

[1] Address by Rear Admiral Perceval S. Rossiter, Surgeon General, U. S. Navy, delivered October 4, 1937 at The Ninth Annual Medico-Military Symposium, held in Rochester, Minnesota.

No system of logistics can succeed which ignores the simple but fundamental problem of trained personnel.

Another essential factor is morale. In a Naval engagement, particularly, it is a reasonable assumption that vessels of the defeated fleet will suffer most severely and it is well recognized that morale will be an important, possibly crucial, factor in determining the victor. Morale is an intangible sentiment that requires a careful and long build-up. It is the fruit of a leadership that inspires confidence, trust and enthusiasm in a crew. The psychology of a crew is difficult to analyze or predict. The men live in close contact, information is contagious and they have a surprisingly accurate estimate of the military situation and of their superior officers. Few officers aboard ship can contribute more to the upbuilding of morale than a medical officer who has the trust and good will of the men. High morale makes a combat unit more effective and, when such a unit suffers damage, tends to minimize casualties by more prompt and efficient action. Morale is one of the important intangible and unpredictable variables in our logistic equation. Incidentally, one of the modern effects of war is to make the morale of our civilian population of increasing importance. Recent developments would indicate that in future wars enemy objectives will include attacks on civil populations in an effort to break down morale. Offense and defense are so delicately balanced with the odds sufficiently in favor of defensive forces that war is becoming a matter of attrition of a nation's entire resources rather than defeat of its armed forces.

Military science is a progressive dynamic force. It presents an ever-changing picture of eventualities in which obsolescence of equipment appears conspicuously. If reports from the Spanish front are to be credited, an antitank projectile has been developed which penetrates the tank and explodes with disintegrating effect on tank and crew. Should a high explosive shell penetrate a turret or magazine the effect would be comparable. Logistics are of slight utility in such eventualities.

The fleet that gains air control can anticipate comparatively few casualties from gas of men exposed in the superstructure. The opposing fleet will be less fortunate. Light unarmored forces like destroyers, submarines, and cruisers are likely to be either sunk or escape with little damage. Heavy and unpredictable casualties may be anticipated in our air force. Here, too, probably few casualties will require treatment or evacuation.

Comparatively speaking, a badly damaged battleship will not present a worse casualty list than that of a regiment after a hard drive. The enemy's objective is to put it out of action. He will very probably be too busily engaged to expend the additional effort necessary to sink it. This will tend to minimize the number of casualties on

the one hand and to increase the number of survivors on the other. The battleship is still the backbone of the Navy. If this were not so nations would encourage each other to build bigger and more costly dreadnaughts, instead of laying special stress on their limitations. When two fleets meet for decisive action this type of vessel must absorb much punishment. They are built to take it. However, a fair percentage of the crew must man battle stations in the superstructure, that is, above the armored deck. Casualties in this force will be unavoidably high. Should the ship survive the engagement those injured will present a problem. The medical organization is aware of this possibility and is disposed and drilled to handle the emergency, each battleship acting as an independent self-sufficient unit. Prompt evacuation of such casualties would be ideal. Unfortunately, the action is too likely to occur far from a protected base, the train which includes our hospital ships is too likely to be at a distant point or destroyed, for us to base our plans on the premise that these casualties can be promptly evacuated. Therefore, each vessel must be prepared to care for its own casualties and hope subsequently for assistance from more fortunate vessels in the vicinity.

The function of a front line fighting unit is intimately connected with, and dependent upon, its source of supply. It is not practical to consider these two items separately. The Bureau of Medicine and surgery is organized with the objective of solving the medical problems and supplying the medical needs of the fleet. To this end it maintains divisions for war plans, personnel, and supplies. The Planning Division is advised of characteristics of ship types projected by the general board and makes recommendations and takes necessary measures to coordinate Medical Department policy with anticipated Navy needs. This division also coordinates Medical Department war plans with those of the Office of the Chief of Naval Operations. Naturally this involves solution of many intricate, detailed, and confidential problems affecting both personnel and matériel. This work is never ending, due to continuing development of the plans. In general, it may be stated that the whole problem of procurement of supplies and equipment is on a far better footing than that which obtained during the last war. It is primarily in this division that our logistics are developed. The details are too involved to permit discussion in the brief time I have. Most of these details would prove an uninteresting recital of factual material were I at liberty to discuss them. Furthermore, should I give a detailed report now, my account would soon be inaccurate due to a high obsolescence factor.

The Navy maintains a close liaison with the Army in our procurement program. This includes assignment of naval medical officers as students at the Army Industrial School.

We maintain medical supply depots at Brooklyn, San Francisco, and at Cavite in the Philippines. These bases keep a substantial supply of consumable and nonconsumable supplies. The former we speak of as supplies, the latter equipment. These depots are manned by personnel experienced in procurement and testing of material for quality. This organization can be readily expanded to meet the needs of our fleet. With few exceptions, our needs in an emergency will be as at present, except for quantity. In fact, the tendency will be to simplify stock to permit carrying of larger quantities of essentials. The objective of this entire organization is to promote the fitness of the fleet for action.

There is a close coordination between the Bureau of Medicine and Surgery and other shore activities and the fleet. This is effected through the fleet surgeons and reports from the fleet medical officers. The Bureau receives a large volume of reports from forces ashore and afloat which is correlated by the Bureau and permits an accurate appreciation of fleet conditions and serves as a basis for estimating future needs.

There is a medical officer on the staff of the commander in chief of each fleet. He is in a strategic position where he can anticipate fleet movements and consequently estimate Medical Department needs. Through reports and personal contact he has intimate knowledge of the medical activities in the fleet. He maintains liaison with the Bureau and with military and civilian medical activities ashore. After action he is in a position to make sound plans and recommendations as to procurement and disposition of personnel and supplies and mobilization of relief forces and disposition of casualties.

In addition to information from the fleet surgeons, the Bureau receives reports from all medical officers afloat. These officers submit many practical suggestions of great value in formulating Medical Department logistics.

Obviously, Medical Department logistics must be predicated on the type of campaign anticipated. The brief time at my disposal and the nature of the subject require that I limit my comments to a general discussion. Therefore, we will consider our logistics from the standpoint of a first-line vessel. To man this vessel will require, as a maximum, an increase of about one medical officer and six enlisted men.

The Bureau maintains a liberal policy toward the fleet in the allocation of supplies and the variety is such that few, if any, new items should be necessary. It is the present policy of the Bureau to maintain aboard each ship a stock of all items which will never fall below the requirements for 6 months under normal conditions and in addition a reserve of the supplies necessary for operation of battle dressing stations and for first aid at the various battle stations. To outfit the ships for war service it will only be necessary to augment the stock on

hand sufficiently to provide for the increased rate of usage which will result from war conditions. Provision has been made whereby this augmentation may be accomplished expeditiously for mobilization. Equipment in addition to that normally aboard should not be necessary. The war stock is based on the presumption that while the vessel may be required to subsist for months on medical stores aboard, it will, prior to resupplying, experience only one major engagement. Therefore, provisioning a ship for action with medical supplies presents no serious problem, particularly in view of the fact that our hospital ships will accompany the train of the fleet and serve as a source of supply.

Preparation for action will include intensive training of the crew in first-aid measures. During action the duty of all hands is to promote the offensive and defensive power of the ship and as many effectives as possible, or necessary, must be kept at their battle stations. The Medical Department is equipped and deployed to promote this objective. After action casualties will be collected at the most accessible dressing station. We make only a generalizing attempt to predict the number or nature of the casualties. The important issue is to provide each ship with competent medical officers and ample supplies. That we can do and have the confidence that whatever happens the Medical Department will render the best service that conditions permit. Evacuation will depend on directions from the higher command on consultation with the fleet surgeon.

The Medical Department of a vessel may be required to accompany a landing force. The fleet is prepared to put armed forces ashore. When Long Beach was paralyzed by an earthquake in March 1933, the fleet had a patrol force of more than 1,000 armed men ashore in less than an hour. The organization of this force is very similar to that of the Army. Each first-line vessel furnishes a battalion accompanied by a medical officer, hospital corpsmen, and stretcher bearers. Equipment consists of medical and surgical supplies packed in cases and first-aid pouches provided and reserved for this particular use. Should a large force be involved, the hospital ships will carry supplies and equipment, including tentage, to set up field hospitals ashore. Our planning division has devoted much effort to developing landing force equipment which was recently reviewed by a board to effect improvement and modernization. Duty with marines has proven an excellent field test for this equipment, and excellent training for our medical personnel. Many of our medical officers have served with marines and some I regard as experts on field service.

On service of this type also we must be opportunists. Few contingencies, or the means of meeting them, can be anticipated with exactitude. For instance, the Managua earthquake was a tragic affair in which one of our experienced medical officers was killed.

This emergency was met by flying medical personnel and supplies to Managua from one of our large aircraft carriers which fortunately was not far off the coast at that time. This emergency assistance was later augmented by reenforcements from the hospital ship.

You have probably noted that I have quoted few figures. There are some that I dare not quote; there are others that I frankly do not know. In either case they will probably soon be obsolete. My real concern is with policy, personnel, and practice. If I can keep the Medical Corps soundly grounded in these I have confidence that our logistics will be effective.

MEDICAL SUPPLY PROCUREMENT IN THE NAVY

By Commander W. H. MICHAEL, Medical Corps, United States Navy

Naval medical procurement began for the then un-United States when, in 1776, Massachusetts built 10 sloops of war and provided a surgeon for each. The captain at first picked his surgeon, and the surgeon procured his medical and surgical "case." The literature contains many curious descriptions of the drugs and the formidable array of instruments, tools would be a more exact word, that the surgeon's case should contain. What it actually did contain was left to the surgeon and the captain.

In sailing-ship days if the sailmaker needed canvas for a sail, or the ship's surgeon peruvian bark, each would tell the "old man." The purser had charge of the ship's moneys. Accordingly, if the "old man" approved, he would authorize the sailmaker and the surgeon to see that the purser bought for them what they wanted.

Today the Navy buys few sails and no peruvian bark. The purser's title has been changed to supply officer. In routine cases the "old man" usually delegates some of his authority to his executive officer. "*Plus ça change, plus c'est la même chose.*" The centralized procurement for the ship remains the same. And because the wants of the Navy are presented as ship's wants, the centralized procurement for the ship has been extended to centralized procurement of the Navy.

This centralized procurement is largely achieved by the Purchase Division of the Bureau of Supplies and Accounts. The head of that Division put it essentially this way: "The Bureau of Supplies and Accounts is a service organization: to coordinate the needs of the Navy; to unwind the required 'red tape' in procurement contracts to the satisfaction of Navy regulations and the Comptroller General; to forecast from our accumulated data where and how wants can be satisfied; and to make purchases to the best advantage through our many purchasing officers. We make no pretense of having the necessary technical knowledge. We get that from the requiring bureaus by turning over bids to them, or in simpler cases, talking over the case by telephone."

The Purchase Division of the Bureau of Supplies and Accounts is divided into the following subdivisions:

1. Schedule section, which receives requisitions and, if they cannot be satisfied by transfer from existing Government stocks, determines where purchase is to be made. Schedules are prepared if standard specifications do not exist. These schedules are sent out to listed bidders by the mailing subsection. If standard specifications and contracts exist for the item, the requisition is handled by the specification subsection.

2. Award section, which opens bids and places contracts, or consults with a technical bureau and is guided by the recommendation of that bureau in placing awards when the lowest bidder is offering an alternate item or an item not meeting the required specifications.

3. Contract section, whose function is evident.

4. Adjustment section, whose function is best portrayed by its unofficial name "Grief section." Being centralized and experienced in the various difficulties arising between contractors and bureaus, usually through misinterpretation of specifications, this section is especially qualified to adjust differences.

Central Control of Procurement

Central control of procurement for the Medical Department of the Navy is the function of the Finance Division of the Bureau of Medicine and Surgery. This office operates under the direct supervision of the Assistant Chief of the Bureau, assisted by chief pharmacists and pharmacists. These officers have invariably been trained by long experience in the Medical Department and most have had special instruction in purchasing and accounting. Many in the naval hospitals and all holding important positions in the Finance Division of the Bureau of Medicine and Surgery hold diplomas in their specialty of accounting and commercial law.

This division has the following sections.

1. Administrative, including preparation of Bureau annual estimate of expenditures.

2. Procurement, which reviews and recommends action on all medical requisitions, except emergency requisitions.

3. Auditing, which controls the accuracy and form of all medical expenditures.

4. Bookkeeping, which has its obvious function.

Annual Estimate of Expenditures

The Constitution of the United States empowers the Congress to appropriate the general funds of the Treasury for public expense. This power is coupled with a corresponding duty, namely, to provide the general funds. This situation gives birth to the two-sided device commonly known as the "Budget." The Bureau of the Budget, a

division of the Treasury Department, was created by an act of Congress in 1921. This office, under the direction of the President, is charged with the duty of assembling, arranging, and presenting the National Budget to the Congress. This act also required the head of each governmental department and establishment to designate a "budget officer" to assemble, arrange, and present that activity's estimates to the Bureau of the Budget. The Chief of the Bureau of Medicine and Surgery is charged with the preparation of an annual estimate of expenditure for funds needed to carry out the duties of the Bureau for the following fiscal year.

The preliminary estimate of expenditure by the Bureau of Medicine and Surgery for probable requirements for a fiscal year is based upon past experiences, Navy policy, operating force plan, and the advance year estimates of expenditures which the Bureau requires to be submitted by each activity, except ships, for sums desired to carry out their respective duties.

These field estimates must be prepared and submitted on or before March 1, 16 months prior to the fiscal year. They are presented in a form closely resembling that submitted by the Bureau of Medicine and Surgery to the Bureau of the Budget. These estimates are examined carefully, due weight being given to past performance, probable future duties, and supporting data. Unsupported estimates for nonrecurring items are given little attention. Detailed information concerning these items is necessary to favorable action.

On the basis of this correlated data the preliminary annual estimate of expenditures is prepared for the Surgeon General by the Division of Finance. It is submitted to the Navy budget officer who prepares and presents a summarization of all estimates to the Secretary of the Navy for approval. Here the policy of the Navy Department is determined and conflicting interests adjusted. The limit of all estimates is fixed and each bureau is instructed to revise its estimates if such is indicated.

The final draft of the preliminary estimates is then prepared by the respective bureaus, returned to the Navy budget officer, where they are summarized and presented with supporting data, break-downs, and other informative facts to the Director of the Budget about September 1, prior to the fiscal year concerned. The estimated expenditures of all bureaus comprising the Navy are then grouped into one "bill" and referred to the congressional subcommittee on Naval Appropriations. Each chief of bureau appears before the subcommittee to clarify or substantiate the estimates. After the "bill" becomes an "act" the Treasury Department issues a warrant to the effect that the funds appropriated by Congress have been, or will be provided, subject to the limitations imposed by the act. Then, and not until then, may the funds be obligated.

The Bureau then compares the funds allocated by act of Congress with the revised estimate of expenditure. If the latter exceeds the former, adjustment downward of the tentatively approved estimates becomes essential and these estimates are again reviewed. The less desirable items are deferred in order to reduce the total to approximate the funds available. Allotment cards are then prepared and mailed to field activities, authorizing expenditure of funds for specified purpose.

Allotments as employed by the Bureau of Medicine and Surgery may be classified as (*a*) money credits and (*b*) material credits. Money credits are actual allocations of funds from a specific congressional appropriation for the current fiscal period. Material credits are authorizations for withdrawal of supplies and equipment from stock (naval medical supply depots) measured in terms of money for the sake of convenience. The actual cash expenditure for supplies and equipment issued from stock may involve either current or past appropriations. Thus, requests for nonstocked material under supply depot allotments (material credits) require a rearrangement of Bureau procurement plans and additional allocation of funds to the procuring agency, United States Navy Medical Supply Depot, Brooklyn, N. Y.

Example of Equipment Procurement

The method of purchase and installation of a new X-ray equipment for a naval hospital will serve both to illustrate the functions of the Purchase Division in its relations with medical procurement, and to show the steps taken by the Medical Department itself. While the procurement of many medical supplies is almost automatic, the following example represents the painstaking procedure that must be followed for procurement of equipment:

1. The commanding officer of a hospital first justifies replacement of the present X-ray equipment on account of obsolescence, costly maintenance, unsatisfactory performance, or other sufficient cause and places in the hospital advance year estimate a budget item of $7,000—$12,000 for a new outfit. The Bureau reviews the recommendation, approves the replacement, and incorporates the item in the annual estimate of expenditure for the hospital.

2. The chief surgeon, the roentgenologist, and the materiel officer have already studied available catalogs and have written up specifications to cover type of outfit required by the hospital. The commanding officer examines these, and as an example, adds the requirement that the bidder guarantee certain servicing conditions. He then forwards the requisition, floor plans, and other essential details to the Bureau of Medicine and Surgery and appoints a board of survey to recommend disposition of the old equipment.

3. The Finance Division examines the specifications, and other data submitted, gets technical advice from the medical supply depot,

engineers, and manufacturers, consults with the Bureau inspector of Medical Department activities, and investigates all the features of procurement preparatory to laying the proposition before the chief of bureau who passes upon all prospective replacements of such a nature. If the chief of bureau approves the procurement the requisition may be forwarded directly to the Purchase Division of the Bureau of Supplies and Accounts, or if the specifications have been modified, it may first be returned to the hospital for concurrence in the modifications.

4. The schedule section of the Purchase Division of the Bureau of Supplies and Accounts verifies the form of the specifications and prepares schedules inviting bids from the several X-ray firms on the accepted list. The mailing subsection sends them out. The bidders make up their bids, execute a bond, and send in both.

5. On the day specified in the schedule, the bids are opened and classified by the award section of the Bureau of Supplies and Accounts and are sent to the Bureau of Medicine and Surgery for recommendation. The latter bureau finds that the lowest bidder, "A," does not assure sufficient protection against radiation and that the next lowest bidder, "B," does not have satisfactory service and replacement facilities near the hospital. Therefore the Bureau returns the specifications to the Bureau of Supplies and Accounts recommending bidder "C."

6. The award section of the Bureau of Supplies and Accounts may assure itself of the Comptroller General's approval, if there is doubt about the reasons for refusing "A" and "B."

7. The contract section draws up the contract because the amount is over \$500. The contractor executes a performance bond which begins at 50 percent of the contract price at \$500 and decreases inversely with the amount of the contract, to 10 percent. The contract is then signed by the contractor and by the Bureau of Supplies and Accounts. The original signed copy is filed. Copies are circulated to all concerned.

8. The X-ray apparatus is installed. It is inspected and demonstrated by the roentgenologist who knows how it should function, and by the material officer aided by an electrician, probably borrowed from Yards and Docks, to check the details of the specifications.

9. If difficulties are encountered in installation, test, or performance, the matter is taken up directly with the contractor, and then if necessary, through the adjustment section of the Purchase Division, Bureau of Supplies and Accounts. The contract price is paid when the commanding officer of the hospital states that the installation satisfactorily meets specifications.

10. The amount is paid by the Bureau of Supplies and Accounts out of the Bureau of Medicine and Surgery's appropriation and the

amount is reported as an expenditure by the hospital. The same amount is taken up on the hospital inventory as representing the cost of X-ray equipment.

11. The Board of Survey can recommend either that the old X-ray equipment be destroyed as of no value, or estimate it's value and recommend that the apparatus be turned over to the supply officer for sale. This survey report is made on the appropriate supply and account form and forwarded to the Bureau of Medicine and Surgery either with or prior to submission of requisition for new equipment.

12. The equipment is disposed of as directed by the Bureau of Medicine and Surgery endorsement on the form returned to the activity initiating the request. This is essential because: "The medical officer in command of each hospital and the medical officer of each station and ship shall be responsible and accountable for all public property under his control belonging to the Medical Department of the Navy."

Approximately the same procedure is followed in all important nonstandard installations. Should the serviceability of any construction or installation be questionable (particularly in naval hospitals), the Bureau of Yards and Docks (which is charged with all construction ashore) should be called upon to inspect, and make estimates and recommendations as to repairs, replacements, and improvements.

The commanding officer of the hospital will then act on his estimate of the situation, by forwarding to the Bureau of Medicine and Surgery the recommendation of the public works officer and his own recommendation. These recommendations will be considered by the Navy Department and the public works officer will be authorized to effect such changes as the Department approves. The cost will be charged to appropriate funds.

Payment in all cases: "All purchases and payments therefor shall be made under direction of the Bureau of Supplies and Accounts and orders directing such purchases and payments shall be given only by that Bureau. When purchase requisitions have been approved by chiefs of bureau, they shall be transmitted to the Bureau of Supplies and Accounts for action." Supply officers represent the Bureau of Supplies and Accounts. In medical activities attached to Marine Corps units, the quartermaster of the Marine Corps exercises for the medical activity the same local functions as would the supply officer of a naval unit.

Role, Bureau of Medicine and Surgery: But although the Bureau of Supplies and Accounts procure, the Bureau of Medicine and Surgery "shall require for all supplies, medicines, and instruments used in the Medical Department of the Navy. It shall have control of the preparation, reception, storage, care, custody, transfer, and issue of

all supplies of every kind used in the Medical Department for its own purposes."

Medical Supply Depots: To facilitate these functions as regards medical materials the Bureau of Medicine and Surgery has created the following central sources of supply:

Naval Medical Supply Depot, Brooklyn, N. Y.
Naval Medical Supply Depot, Mare Island, Calif.
Naval Medical Supply Depot, Canacao, P. I.

The Brooklyn Depot is the main supply depot and keeps on hand Supply Table and Supplementary Supply Table material. There are specified limitations on the items kept in stock by the other depots.

Certain special supplies, itemized in the Supplementary Supply Table, as antigens, culture material, bacterial emulsions, containers for specimens, typing sera, and colloidal gold, are prepared and supplied by the Naval Medical Center in Washington, D. C.

The medical supply is predominately automatic. These supply facilities render almost automatic the acquisition of at least 90 percent of medical supplies used by the various medical organizations. This is accomplished by the supply table, adopted in 1926 and revised in 1938. In addition to individual items it lists a score or more of assembled outfits, viz: Aircraft first aid, emergency surgical, box medical, chest operating and expeditionary outfits, etc.

It includes a complete list of ordinary dental supplies.

Requisitions from each activity for every need on the supply tables are made on the prescribed form. This shows the amount of the items on hand and the amount required. The requisition is forwarded to the Bureau of Medicine and Surgery where it is approved or revised and forwarded to a medical supply depot for execution. An emergency requisition goes direct to the supply depot for execution and a copy goes to the Finance Office for record, or it may be made by radio and the red tape unwound at leisure. Medical supply depots replenish their supplies by requisition approved by the Bureau of Medicine and Surgery and procured by the Bureau of Supplies and Accounts, usually in New York City markets.

Factors governing requisitions: There must be a specified minimum of supplies on hand in each activity and aboard combatant ships and an additional reserved stock of such unopened, original units of supplies and items as may be specified by the Bureau of Medicine and Surgery. This minimum stock for ships is 6 months' supply, based on a 3-year average consumption. For hospital ships and all shore stations, the minimum prescribed is 1 year.

An "order point" has recently been established. The stock of an item has reached the order point when it has been reduced to a point that, considering average consumption and time required to requisi-

tion and receive new stock aboard, the stock on hand would be depleted to the minimum supply on estimated date of replenishment. Routine orders for deficient items should be made following quarterly inventory with such minor variations to facilitate delivery, as are dictated by the movement of the ship. On receipt of supplies, that portion of the reserve supply which deteriorates should be replaced by new material and the old reserve removed and designated for current use. In other words, always use the oldest stock, first. A careful attention to this method will bring about a decrease in dead stock and insure fresh material in reserve. Formerly there was often an accumulation of unreasonable supplies. An inspection of one hospital revealed a supply of quinine hydrochlorosulphate sufficient at the average rate of use for several hundred years.

The medical officer is expected to requisition what he needs provided his requirements do not exceed his annual allowance for supply depot items. This allowance may be increased on request, in emergency, by the Bureau of Medicine and Surgery. He is expected to be governed by the prospective mission of his ship, his own methods of treatment and other conditions affecting his requirements. If he is a genitourinary specialist he will order his favorite catheters from the Supply Table. If his ship is going up the Yangtze he will order cholera vaccine; if she is going on a long "shake down" cruise, he may wish to take along a couple of caskets for the care of the dead.

Supply Depot material awaiting transfer to ship or station is delivered to the Supply Department which supervises shipment and delivery and pays transportation costs.

The Medical Department of a naval unit obtains material from sources and by methods other than on regular supply depot requisition. In emergency medical material may be transferred directly from one Navy medical activity to another on regular transfer form a copy of which is forwarded to the Bureau of Medicine and Surgery. In case of transfer of equipment prior permission should be obtained from the Bureau or, in case of emergency, an explanatory letter should accompany the copy of property transfer.

Numerous items of sick bay equipment such as office furniture, lockers, steam and electric sterilizers and various ward installations are the property of other divisions. They are issued to the medical division on custody receipt signed by the senior medical officer. Cleaning gear and other sanitary supplies are issued by the first lieutenant on signed request without charge to the Medical Department.

The Bureau of Medicine and Surgery has endeavored to be sufficiently liberal in the variety of supply table and supplementary supply table items offered and the allocation of funds for their acquisition. It views with disfavor the indiscriminate use of emergency and other irregular forms of requisition. For the exceptional situation that

demands irregular procedure one of the following described methods of obtaining material may be employed:

(*a*) Supply table items may be obtained in emergency by making requisition on regular form or by radio directly on the nearest supply depot. Copy of requisition with explanatory letter should be forwarded to the Bureau of Medicine and Surgery.

(*b*) For ships and stations essential materials not listed on the Supply Table or Supplementary Supply Table may be obtained by forwarding a special requisition, using the standard form, to the Bureau of Medicine and Surgery. If funds are available and the requisition is approved, the Bureau will direct a medical supply depot to make procurement. If a detailed explanatory letter accompanies the requisition the Bureau of Medicine and Surgery will be in a better position to evaluate the necessity for providing the special material.

(*c*) Material may be obtained on purchase requisition approved by the commanding officer and purchased by the supply officer. Actually, in this type of emergency procurement, the purchase is usually made immediately by the supply officer and the necessary red tape is unwound afterward.

(*d*) Procurement by "improvision" is a method of importance, especially aboard ship, by which the efficient medical officer obtains material through the cooperation of other departments. If in great emergency he wants a baking box for stiff joints, a violet-ray lamp, a walking splint for a broken femur, a suspension apparatus for a broken back, or even an oxygen tent for a pneumonia patient, he has only to exercise the necessary diplomacy and ingenuity.

Procurement by improvision has played an important part in the Medical Department of the Navy. The first two naval hospitals and the first hospital ship were of natural or improvised birth. Edward Cutbush, surgeon of the *Constellation* then operating against the Barbary States, established and conducted the first United States Naval Hospital, in Syracuse, Sicily, 1806. In 1810 Surgeon Lewis Heerman was sent to New Orleans. Seeing the necessity, and fortified by a personal fortune, as an adjunct to a lucrative practice he purchased a suitable house and a few slaves and started the second naval hospital. The first hospital ship was a Confederate vessel on the Mississippi captured during the Civil War. This ship, the *Red Rover*, was equipped by Admiral Porter and put under the command of Surgeon Pinkney.

Insofar as procurement by improvision represents a constructive and expedient opportunism for the good of the service and to meet local emergency and unanticipated needs, the Bureau of Medicine and Surgery cannot object to this method, but cautions that use of this expedient should be reserved entirely to meet such needs.

Dental equipment and supplies are furnished in the same ways as medical supplies and the dental officer has the same responsibilities in regard to them as has the medical officer in regard to medical materials.

PROCUREMENT FUNCTIONS OF MEDICAL DEPARTMENT UNITS

Medical activities which make up what might be called the "consuming echelon" of the Navy Medical Department vary in importance from the Naval Medical Center, through hospitals, sickquarters, field hospitals, sickbays, and dispensaries, to the medical officer of a recruiting station. The first two procure everything necessary for a separate self-sustaining command; the last buys only a few things from the nearest drug store. With the exception of the medical officer on recruiting duty (who does not require a requisition form for medical supplies though he is furnished a recruiting outfit), the procurement of purely medical material is the same and has been explained. But there is considerable nonmedical procurement by medical activities which a short description of the procurement organization of a naval hospital and of the installation of the sickbays aboard a ship and ashore should clarify.

Naval Hospital: The procurement functions of a naval hospital are vested, under the commanding officer, and executive officer in:

(*a*) The first lieutenant, who has general supervision and upkeep of buildings and grounds. Improvements and repairs, beyond the capacity of the hospital force, are estimated by a representative of the Bureau of Yards and Docks and paid for out of the hospital allowances by the supply officer.

(*b*) The property officer, who is responsible for storage, property cards, and requisitions. He obtains medical supplies as described above. Other supplies are obtained by stub requisition from the supply officer; bid and purchase with or without contract; or purchase requisition for specified limited amounts, usually $50. The hospital if authorized by the Bureau can procure the professional services of a civilian specialist. Naval hospitals procure and maintain their own ambulances and other vehicles.

(*c*) The commissary officer supervises the purchase, storage, preparation and cash accounting of commissary material. He uses the local contracts of the supply officer, or makes small open purchases as above.

(*d*) The accounting officer, who in addition to accounting for and submitting the required financial returns, keeps the commanding officer informed of the relation of allocations to expenditures under the various appropriations.

Frequently two, or even three, of these functions are filled by one officer.

Ship: When a Navy ship is being put in commission the Medical Department is furnished only the standard medical and surgical equipment for that type of ship plus any additions which the medical officer might deem necessary. However, the Bureau of Construction and Repair (or the contractor) installs in the sickbay and in the dressing stations, not only the ordinary living accommodations (lights, bunks, plumbing, etc.), but also sterilizers (except dental sterilizers), bacteriological incubators, and operating-room lights, as specified by the ships' design. Even splint stretchers are charged against the Bureau of Construction and Repair as is the material necessary for the fumigation of ships.

The wise medical officer will constitute himself as procurement and property officer. He will, as required by regulation, keep personal custody of the medical storeroom key and personally supervise custody and issue of alcohol and narcotics. He will assign property accounting to a reliable corpsman and will assure himself beyond doubt that the property records are accurate, that the stock conforms with Bureau policy and has not deteriorated.

Shore station: Like the sickbay of a ship, shore sickbays and dispensaries are furnished certain items by other departments than the Bureau of Medicine and Surgery, because these medical activities are considered an integral part of the naval establishment. The items include buildings, furniture, light, heat and water, cleaning material, floor polishers, etc.

The Medical Department's problem of procurement for shore stations is simplified by a system of 3-year planning. In March, each year, the estimates for the following fiscal year are reported in detail. Later, provisional estimates for the following 2 years are submitted. In this way the Bureau reduces unpleasant suprises to the minimum. This 3-year estimate is not required of ships whose yearly expenditures vary somewhat, but ship variations do not assume the fantastic proportions as do those of some hospital and other shore station estimates.

Source of Funds

The funds of the Bureau of Medicine and Surgery are derived from:

1. Annual appropriations for "Medical Department," "care of the dead" and "salaries, Bureau of Medicine and Surgery."

2. Naval hospital trust fund: This trust fund derives its revenues from within the naval service, namely: 20 cents a month levy on all naval personnel, fines and forfeitures, pensions relinquished during hospitalization, forfeitures by deserters, and the ration value of all naval patients. "Every expense for the proper establishment and maintenance of a naval hospital may be paid from this fund except as Congress may provide for certain expenses by specific appropriations." The revenues of this fund approximate $800,000 annually.

Procurement Preparedness

The minimum supplies required at all naval activities and the "1 year, plus procurement time" minimum required (and exceeded especially in strategic drugs) at naval medical supply depots, would furnish a substantial outlay on M-day. Ships actually have prepared and sterilized a reserve supply of shell-dressings. War plans are prepared for the naval districts with complete requisitions to take care of expansion. It is believed that these requisitions can be promptly filled with the exception of about a score of items of technical nature. An effort is being made to provide such items but, owing to the rapidity of their obsolescence, this acquisition, even if authorized, will be limited to 5 years peacetime consumption. The medical department is prepared to equip the fleet and the auxiliary ships. Gaps in the shore establishments can be filled later.

MEDICAL DEPARTMENT FUNCTION IN A NAVAL ENGAGEMENT

By Capt. C. J. Holeman, Medical Corps, United States Navy

As stated on the cover of this Bulletin the Mission of the Medical Department is "To keep as many men at as many guns as many days as possible." Surg. H. E. R. Stephen, R. N., has thus defined the duty of a naval surgeon aboard a fighting ship: "To render the ship an efficient fighting unit as far as lies in his power." This is true, but such a definition might be applied to every person aboard a fighting ship. Specifically, the medical officer should, in peace time, bring the crew of his ship to the best possible physical condition and the ship itself to conformity with highest possible sanitary standards. By his prebattle arrangements he should seek to maintain these levels of fitness during action. By the execution of his previously prepared, and sufficiently rehearsed, battle plan he must strive to keep the greatest possible number of officers and men in physical condition to execute their assigned tasks unhampered by those rendered unfit for further service by severe injuries. Hence, for the medical department of a naval vessel in battle there might properly be assigned the

MISSION

To Sustain the Physical Fitness of the Personnel in Order to Maintain the Fighting Efficiency of the Ship

To accomplish this mission three major tasks devolve upon the medical department.

1. To preserve the highest level of physical fitness at all battle stations,

2. To promptly and efficiently care for the wounded during lulls in action or after battle,

3. To evacuate noneffectives.

Progress in naval architecture whereby, as the result of an extensive system of compartmentation, fighting ships have gained greatly in floatability; improved weapons of such power that the watertight integrity of compartments may not be impaired without hazard; and probable use of chemicals, which has added requirements of fume tightness, have led to the development of the present system of damage control on ships of the Navy. These have complicated the arrangements of preparing the medical department for battle, and drastically modified its functioning during action.

During the past 3 years this matter has been made the subject of study by many boards and individual officers in the fleet. The latest study has resulted in the promulgation of Fleet Memorandum 29M–37, by the commander in chief, during November 1937. In this memorandum two fundamental principles were enunciated:

(1) The watertight integrity of the ship, regardless of wounded, must be preserved.

(2) Fire power, as delivered by the batteries of the ship, regardless of wounded, must be maintained.

These principles must determine methods employed to accomplish the tasks enumerated.

Analysis of the Tasks

Task 1. To preserve the highest level of efficiency at battle stations

With rigid enforcement of regulations governing watertight and fumetight integrity, not only during actual fighting but during the periods when conditions Affirm or Baker must be maintained, members of the crew at most battle stations will be isolated from the medical department personnel of the vessel. Hence, the only manner in which the medical department can contribute to sustaining physical efficiency of the combatant force during these phases is:

(*a*) By careful and thorough (pre-battle) instruction of all hands in first-aid treatment of wounds, burns, and contact with chemical agents, so that first-aid may be effectively applied by the injured man or by a shipmate at his battle station;

(*b*) By having adequately stocked first-aid outfits at all battle stations;

(*c*) By providing a team of well-equipped competent first-aid men attached to each damage control party who shall, whenever these parties gain access to a battle station, inspect personnel casualties, administer or correct defects in first-aid treatment, do everything possible to combat shock and relieve pain, and, if practicable, remove the seriously wounded from the compartment.

Task 2. To promptly and efficiently care for the wounded during lulls in action or after battle

The execution of this task will demand the maximum of effort, skill, and judgment on the part of every officer and man of the medical department. In the proper performance of duty at this time the medical department has, perhaps, its greatest opportunity to contribute directly to military efficiency of the ship. This contribution consists not only of a manifest conservation of man power but of a strong support to morale at a critical period.

The operations necessary are:

(*a*) To restore to fighting efficiency the wounded, men made ill by prevailing battle conditions, and those incapacitated by the milder effects of chemical agents. These will find their way by designated routes to the proper dressing stations.

(*b*) To clear the gun and other battle stations of the more seriously wounded. These must be helped or carried in litters to the battle dressing or chemical decontamination stations.

(*c*) To treat those whose injuries incapacitate them for duty. These operations are set down in the chronological sequence in which they must be completed; actually there will be some overlap in their execution.

Task 3. To evacuate the noneffectives

This consists of two phases:

(*a*) Clearance at first opportunity from battle stations.

(*b*) Evacuation after treatment from the ship to a hospital ship or hospital.

Detail as to the manner in which these major tasks are to be accomplished must be worked out for each ship by its medical officer. Approval by the commanding officer must be obtained as a matter of routine. Such planning and approval, however, must not be perfunctory for the successful execution of the tasks demands complete cooperation between the medical department and other departments aboard ship. Instruction in first-aid of the nature required demands joint interest of the medical officer and division officers; treatment and clearing of patients during action requires full cooperation between the medical officer, damage-control officer, and central control, and when the battle is over, between the medical department and practically all hands.

MEANS OF ACCOMPLISHING THE TASKS

Task 1 (*a*).—*Training in first aid* assumes, under present conditions, greater importance than has been heretofore attributed to it. Its value in controlling hemorrhage, guarding against infection, diminishing mortality rates and lessening total sick days must be clearly

explained to all hands. But the two fundamental principles enunciated by the commander in chief impose a new responsibility upon medical officers to instruct and division officers to know that their men understand not only the value of first aid but that each member of a gun crew or other unit engaged in fighting the ship knows the use and mode of application of every item in the battle station first-aid locker or bag.

Fleet Memorandum 29M–37 prescribes that men detailed to serve as collecting parties of stretcher men shall be "sufficiently trained in first aid to act as relief hospital corpsmen in emergencies, especially the emergency of battle." During battle, persons attached to repair parties will, when access to compartments is gained, provide the maximum relief that the medical department can afford at this phase of the battle.

Treatment of shock is of such vital importance that careful provision should be made therefor. This implies, at the present state of our knowledge, immediate use of morphine. There may be cases in which seriously wounded will have a considerable wait before help may be brought to them. Decision should be reached as to whether or not first-aid instruction to officers, to leading men in battle stations where no officer may be present and to the collecting parties should include the administration of morphine.

Task 1 (b)—Battle station first-aid material.—Major ships are now provided with metal containers for the first-aid outfits of battle stations. Greatest care should be exercised to see that an outfit is provided for every isolated group of men.

The problems of storage at a central point for issue at general quarters or their permanent distribution throughout the ship, periodic overhaul, keeping them stocked with material in no wise deteriorated or keeping them partially stocked in peace time with earmarked material in the storeroom to complete their allowances, are all matters for individual ship decision. Unless containers are kept locked they will be broken into and undesirable self-treatment will spring up. Since they may be used in minor emergencies during drill with benefit, on several ships a scheme of sealing them with easily broken seals, the damage to which is easily observable has proven satisfactory. In any event, a certain number must be used for instruction purposes.

No useful purpose would be served by listing contents of the lockers. Provision must be made for wounds from projectiles, burns, damage from chemicals (whether thrown aboard by the enemy or from gases generated by explosion of enemy shells or by own propulsive charges), contusions and other injuries by mechanical devices. Types of injury most likely to occur at each battle station should be considered and the locker for that station fitted up accordingly.

The relative importance of burns should be borne in mind. At the battle of Jutland, omitting killed, the ratio of burns to wounds on major ships was as 154.5 : 100. This ratio is not due to especially large contributions by fireroom and engineroom casualties but rather to the flash of enemy shell explosions within the ships. At present the tannic acid treatment of burns is in favor and has much to recommend it.

Quick availability, simplicity of application, sufficiency without waste or jeopardy to stock by haste or nervousness were the indications which led to the adoption of item S1–190, tannic acid jelly, for inclusion in the supplementary supply table. Should service test prove the value of this item, it offers an excellent solution to the problem of caring for burns. Reports on its use will, therefore, be appreciated by the Bureau.

Medical officers should give immediate attention to the segregation of sufficient stores for their battle station outfits. By Bureau's Circular Letter, Serial No. 640–1937, ships are directed to maintain a minimum stock plus a working stock in addition to their reserve stock stored at battle dressing stations or in other emergency units.

Task 1 (*c*)—*First-aidmen.*—Provision of nonmedical first-aid personnel for collecting parties has been considered under (*a*) above. It is highly desirable that to each such party there be assigned a pharmacist's mate who shall be in charge of the task of caring for personnel casualties in any compartment to which the damage control party may gain access. The administration of morphine is a matter in which the judgment of a hospital corpsman is apt to be safer than in less experienced hands. The presence of a member of the hospital corps in whom his shipmates feel a degree of confidence, directing these operations, will tend to support morale. Furthermore, the training of the corpsman is such that remedial measures known to him may be used to add to the safety and comfort of the wounded or those made ill by prevailing conditions.

Task 2.—*Treatment of wounds* at the earliest possible moment is important in reducing mortality rates, shortening duration of ineffectiveness, and relieving pain, and requires no comment. Likewise that efficiency of medical officers and methods employed contribute directly to such results is patent to all. Yet there must be some definition of efficiency since personnel and facilities are limited at best and the first may be reduced by casualties while the latter may be well nigh destroyed. Furthermore, in precisely those cases where facilities are most completely wrecked the task confronting the medical department is apt to be greatest. The percentage rates of wounded vary greatly on individual vessels, and by ship types; in fleet actions as opposed to single ship duels and most appallingly as between victorious and vanquished units.

It has long been assumed that for a victorious ship engaged in a decisive fleet action a fair assumption of total casualties would be 20 percent of complement, of these that 4 percent would be killed, that 8 percent would be seriously wounded. That in single cruiser encounters approximately 15 percent would be killed or wounded, the ratio of killed and wounded being about the same.

At Jutland total British casualties fell considerably below expected rates. Of the total strength of the fleet the percentage of casualties was 11.16 (10.04 killed and 1.12 wounded). These figures over-emphasize a trend, which had previously been noted, toward a greater ratio of killed to wounded. It must be remembered, however, that Jutland was an undecisive battle, all ships did not participate and the death rates were greatly increased by the explosions and sinking of major ships with all hands aboard.

Differences in armor protection accounts for variances in casualty rates, in proportion of killed to wounded and the nature of casualties. H. M. S. *Lion*, a battle cruiser had a percent casualty rate, at Jutland, of 11.85 (7.7 killed, 4.15 wounded); H. M. S. *Barham*, a battleship, had a percent casualty rate of 6.04 (1.93 killed and 4.11 wounded). Burns by flash, appear, on the other hand, to increase in relation to wounds by projectiles in direct proportion to the thickness of armor.

As for difference between rates for victorious or vanquished ships they may be practically zero on the one hand and approach 100 percent on the other. At Tsuishima the defeated Russian force had about 30 percent casualties, while 16 percent has been assigned as the probable Japanese rate for the whole campaign. In the single ship action between the *Sydney* and *Emden*, the former had 4 men killed and 12 wounded, the defeated *Emden* had 40 percent casualties.

These data are introduced here only for the purpose of calling attention to the possible magnitude of the task presented.

Faced with the immediate care of 16 percent of the crew, obviously efficiency of immediate treatment precludes the possibility of finished surgery. Of this Fleet Surgeon Christopher L. W. Bunton, M. B., R. N., says:

> My experience in a double role, that of an operating surgeon in a hospital receiving wounded from ships after an action, and that of a surgeon in charge of a ship sustaining many casualties in the battle of Jutland, leads me to deprecate strongly the performance in dressing stations of operations which could be deferred with safety till patient had been transferred to the more favorable conditions obtaining in a hospital ship or shore hospital.
>
> The surgery best adapted for dressing stations during or immediately after an action would seem to be an amplified first-aid treatment.
>
> Operations should be strictly confined to those of an imperative nature, and all efforts be directed to rendering wounds as aseptic as possible, with a view to facilitating the work of the surgeon who eventually receives the case. * * *
>
> Provided they are not causing untoward or dangerous symptoms from their presence, pieces of shell deeply embedded are better left in situ. * * *

The question of amputation of limbs is certainly best postponed till the patient is transferred to a hospital or hospital ship. Of course, where a limb is practically severed, and all hope of its preservation out of the question, it may be quickly snipped off with a view to facilitating patient's locomotion. * * *

Task 2 (a)—Restore effectives to battle stations.—It is assumed that the personnel of the medical department are thoroughly indoctrinated regarding the imperative necessity of giving immediate attention to those, whose wounds being properly dressed, may carry on. To accomplish this during lulls in battle will be of direct military importance.

Will there be a lull in action? Estimates of the probable duration of a battle between modern fleets vary from 20 minutes to 1 hour, such estimates are predicated upon favorable weather conditions and a desire to fight to a finish on the part of both commanders. In such event probably no lulls of sufficient length to warrant relaxation in enforcement of strict watertight integrity would occur. But, at Jutland, the only engagement in which entire modern fleets have participated, the battle largely consisted of lulls punctuated by minutes of fighting. Under such conditions, subject to central control, on vessels equipped with modern quick-acting doors, moderately wounded might well have their wounds dressed, men made ill by combustion gases or with eyes inflamed by tear gas might receive attention.

Task 2 (b)—Evacuation of casualties.—Under the same conditions as would permit the slightly wounded to have their injuries dressed during a lull, the battle stations might be cleared of the seriously wounded. The movement of all collecting parties is subject to central control. The need for special training of the collecting parties is again emphasized for most important tasks devolve upon them in recognition of injuries from chemical agents, in transporting or aiding such cases to the decontamination stations, in avoiding contamination of themselves, and in guarding against taking contaminated litters into the battle dressing stations. Fortunately, if the battle be of short duration most of the cases injured by the now-known vesicant chemicals will not be incapacitated until after the fight is concluded.

Task 2 (c)—Treatment of noneffectives.—The fact that the paramount duty of the medical officer is to promptly restore to his station every man capable of fighting the ship does not mean that the suffering of the seriously wounded shall be ignored. The battle-dressing station country must be in readiness so that men may lie down. Blankets, hot water bottles, morphine (or perhaps, stimulants) must be distributed to control shock as necessary. Their dressings must be inspected and hemorrhage checked if this has not been accomplished at their battle stations or if moving them has disturbed their dressings or tourniquets. Also care must be taken that tourniquets are not left too long in situ.

These tasks must, of course, be performed by hospital corpsmen until such time as the medical officer and his immediate assistants complete task 2 (a). The nature of the surgical work to be undertaken has been considered. There may be cases in which something more radical than high-grade first aid is clearly indicated. The probable time when clearance to a hospital ship or hospital may be accomplished should be carefully considered, and if the delay would be too prejudicial, formal operations decided upon should be thorough and performed in strict accordance with approved technique.

Task 3 (a)—Evacuation of noneffectives from battle stations.—Evacuation of seriously wounded from their battle stations should be accomplished, as indicated under task 1 (c) at the earliest opportunity in order that morale of gun crews (or other working units) may not be impaired by their continued presence in the compartment, and in order that the best treatment possible may be promptly initiated.

Task 3 (b)—Evacuation of noneffectives from the ship.—At first thought evacuation of casualties from the ship might not be considered as falling within the purview of a study of "Function in battle" since, of necessity, the battle is over before it is undertaken. But to omit it would be to fail in fully considering the duties of the medical department incident to the battle. The care of casualties in reality consists of three phases:

1. First-aid treatment at a battle station.
2. More thorough first-aid treatment at a battle dressing station.
3. Definitive treatment in a hospital or aboard a hospital ship.

Only in such exceptional instances as those cited under task 2 (c), or when it is impossible to evacuate the casualties should definitive treatment be conducted aboard a fighting ship. Fleet Surgeon Bunton, previously quoted, says that after Jutland evacuation was accomplished in 48 hours and adds:

> I should be inclined to consider this period as representing the maximum delay of wounded on board, since to more or less exceptional circumstances the fleet remained for a considerable time in the vicinity of the original action with a hope of cutting off the enemy for his base and resuming the engagement. Under ordinary circumstances a period of 24 or 36 hours would probably be the more usual time to count on as available for examining and dressing the wounded.

Supporting Measures

Personnel.—Restudy of personnel requirements on naval vessels has been undertaken by the Bureau of Navigation and requirements of hospital corpsmen to carry on battle activities will doubtless receive careful consideration. The article on Logistics by the Surgeon General in this issue of the Bulletin refers to the necessity for about six more corpsmen on battleships. Such an increase would make

available 19 or 20 hospital corpsmen. A logical apportionment of these would appear somewhat as follows:

To assist the operating surgeons at battle dressing stations	10
To receive and care for sick and wounded	2
To accompany collecting parties	6
To man the chemical decontamination station(s)	1 or 2

It is evident that men detailed to accompany collecting parties will later be available for other duty and perhaps the decontamination station may not be needed. On the other hand, that station may receive many cases and require additional assistance; also as cases accumulate there or at the battle dressing station more men will be needed as nurses; furthermore, no allowance is made for casualties in this tabulation. As a result of the study, both extensive and intensive, which the efficient employment of medical department personnel in connection with effective damage control during action, has received, a considerable volume of opinion has arisen to the effect that the Medical Department's work begins after battle or during a major lull therein; and that, therefore, all such personnel should seek refuge behind armor until the action is over when they should emerge and begin the performance of their duties.

Such conception is repugnant in that, were it accepted, morale would unquestionably be lowered in a force thus isolated without information as to progress of the battle and with no tasks directly connected with fighting the ship. Furthermore, such a conception falls short of a visualization of requirements to accomplish the mission of the Medical Department in battle.

During action, on many ships, repair parties are stationed in spaces immediately adjacent to or, indeed, actually in the area assigned battle dressing stations. When their collecting parties succeed in evacuating seriously wounded patients from battle stations they may be brought in for treatment immediately. While it would be most desirable to have a medical officer detailed to supervise treatment of all injuries at battle stations and the transportation of the more seriously wounded, the principles of economy of force and security prohibit such employment. Medical officers must perforce stand by the battle dressing stations. These stations must be kept manned and equipped, in constant readiness to—

(*a*) in the event of a lull in action, immediately treat those capable of restoration to duty, and

(*b*) attend to the immediate needs of noneffectives brought in by the collecting parties.

Throughout the action hospital corpsmen attached to collecting parties must be alert to maintain the physical efficiency of men at battle stations and to assist in evacuation of noneffectives from these stations.

Battle dressing station.—Modern battle dressing stations are the result of a continuous evolution through the years of development of modern navies to reach the proper solution of the dual problem of best caring for the wounded and supporting morale of survivors.

Fleet Surgeon Bunton stated (about 1 year after Jutland) that a battle dressing station "should be fully protected, easily accessible, thoroughly ventilated, and have a good supply of both hot and cold water with fixed basins and effective water service." To this should be added: "Adequate space for the injured to lie down and to be cared for in" (Fleet medical officer's comments on Medical Department in battle): fixed sterilizers or at least facilities for plugging in portable instrument sterilizers and water heaters, and storage facilities for complete logistic support of the station.

Do the existing battle dressing stations possess these characteristics? As planned on newer battleships they did. At present they are protected by armor and review of plans of battleships indicates that battle dressing stations are as accessible as any place thus protected could be. They are generally well located one deck below the sick bay, where exists the greatest likelihood of conservation of their facilities—lights, water supply, and sterilizers. Access is reasonably free by companionways from the upper decks, and quite generally crew's living spaces are near at hand.

In peace time, except for drill purposes, the Medical Department requires but a fraction of the original battle dressing area assigned by approved plans of the vessels. In fleet medical officer's comments on Medical Department in battle, July 1, 1937, reference was made to "dual purpose assignment" of space. This dressing station space is a most pertinent instance of the value of such a conception. Conservation and efficient use of space does not permit allocation to the Medical Department for its exclusive peace time use all the space that it will require in action.

However, the dual function of the area assigned to battle dressing stations on approved plans of all ships should be such that the deck space may be used as necessary by other departments until the battle dressing stations begin to function. After battle the need for exclusive use of the entire space by those engaged in personnel rehabilitation will probably be imperative.

In order that traffic through battle dressing stations may be reduced to a minimum after battle, the allocation of storerooms should be carefully studied. Those used for storage of items which will be required for material repairs should not open into these areas. Review of battleship plans shows that, in many cases, material which will be immediately needed is now stowed in rooms opening into the battle station areas; while nearby storerooms, equally commodious, are used

for supplies and accounts stores which would not be immediately required. A judicious interchange could probably be effected.

Sufficient battle dressing station space and storage facilities in connection therewith will be provided on new construction. If, on existing ships, encroachments upon battle dressing stations and their required storage space, without due regard to the principle of "dual function" have occurred, medical officers should exert themselves to effect an adjustment with other departments aboard their ships to reestablish the adequacy of their battle dressing stations. In order that such adequacy may be demonstrated it is suggested that periodically there should be held drills in which the number of personnel casualties handled as directed in Fleet Memorandum 29M–37, shall equal 16 percent of the crew.

Ventilation presents a problem new since 1918. With ships' ventilating systems shut down obviously they could not be considered well ventilated—with the ship opened up after action, with the system functioning and its intakes uncontaminated by chemicals, they are as well ventilated as any regions on the third deck.

A matter demanding special study is the protection of battle dressing stations against chemical contamination. The Bureau of Construction and Repair is giving this careful consideration in planning new construction. Contamination must be guarded against in two ways:

(1) The best defense obtainable must be provided by regulation of the ventilating system and such structural protection as may be devised.

(2) Prevention of contamination by entering personnel. This has been touched upon when instruction of litter squads was discussed. A corollary to the rule excluding chemical casualties from battle dressing stations is that chemical decontamination stations must be provided. Such stations, either as designed for new ships, or extemporized on older vessels must meet minimum requirements of:

(*a*) Best possible protection compatible with easy access from upper decks.

(*b*) A space for disrobing and disposition of contaminated clothing.

(*c*) A treatment room.

(*d*) Showers and soap to permit abundant lathering. Fresh water is highly desirable, but abundant salt water and salt water soap are preferable to a scanty supply of fresh water facilities.

(*e*) Space for dressing in fresh clothing.

Water is supplied to the battle dressing stations and water heaters are provided. As a safety precaution the stations have reserve tanks—the rule for these being that the capacity of tanks at the forward and after stations shall be 1 gallon per man for 20 percent of the complement; for the amidships station the capacity is approximately one-half this amount.

Quite generally a cargo light is included in the prescribed equipment for operating table illumination—the remainder of the space must be left to the ship's lighting circuits. In case of failure, battery operated lanterns must be provided. In response to a recommendation of the commander in chief, the Bureau of Engineering has developed a special lighting fixture for the operating table, two experimental units of which have been sent to the fleet for service test.

In an excellent study made by Commander H. L. Jensen (MC), in December 1937, particularly in reference to the battle dressing stations on the *Maryland* and incidentally to those of other battleships, that officer stated that:

"The storeroom which formerly was a part of the after dressing station has now been taken away from the medical department and turned over to the damage control officer. * * * The floor space available (at the forward dressing station) will just permit the erection of a dressing table with two men working on each side. There is no floor space left on which to deposit stretcher cases before or after operation." To this statement is added data concerning the over-running of this area by personnel of other departments. The statement regarding the available space was verified by examining blue prints of the *Maryland*. While the area described is somewhat irregular in outline, the present assigned deck space appears to be less than 20 percent of that allotted thereto on the original plan of the vessel. Encroachments on these spaces have occurred on other battleships.

Accepting the practical obliteration of useful battle dressing stations as a *fait accompli*, Jensen adds: "It is assumed that a naval engagement today will mean great material damage, what with hits by major shells, bombs, and torpedoes. Obviously then, it would be a great mistake to concentrate the medical activities, particularly instruments and dressings, in any certain parts of the ship without making ample provision for the rapid transfer of these activities to some other part of the ship less seriously injured." From these considerations he concluded "* * * that permanently equipped dressing stations and permanent storerooms should be abolished on the newer ships in new construction * * *."

The solution presented was: that after battle the two surgical teams, each headed by a medical officer should seek out "A suitable area on the second deck or above, set up his outfit and go to work. The area chosen must have sufficient space in which to work advantageously, be readily accessible to that end of the ship and be off the main arterial routes. On the newer ships in the Navy, there is no such space below the second deck." "A mop-up squad" headed by the dental surgeon or other competent person was also described whose duty it was to bring the wounded to the selected stations. To equip these extemporized battle dressing stations. * * * "In lieu of storerooms medical equipment should be stowed in lockers, the largest consistant with portability. There should be a minimum of 14 such lockers, scattered about the ship near access hatches, so that after the battle, certainly some of them would be left intact. Each locker should contain as a minimum the following: (a list of proposed contents was here supplied by the author). Two men can easily carry such a locker (one has been made upon this ship and portability proven) and can quickly bring them to the areas chosen by the medical officers as dressing stations. Each locker would be a complete small surgical dressing outfit in itself, and, with several of them, a large number of wounded can be cared for. * * * Likewise

several portable operating tables, on the order of the present field table would have to be provided, six would be sufficient. It must be remembered that no great or finished surgery would be undertaken immediately after the battle, merely enough to preserve life until the patients could be evacuated to a hospital or hospital ship, or until the wounded have all been treated, and then, if time permits, a more finished surgical outfit could be provided for more finished work."

Concerning water it was stated that it "* * * could be put up in tins and scattered throughout the ship. Not only is it imperative to have water at the dressing tables, but drinking water will be at a premium. These cans of solutions can be sterilized in the large mattress sterilizer, 30 or more at a time. The inside of the cans would probably need some sort of plating or other protection, but that is a minor technical problem."

The merit of the suggestion, which has been voiced by other officers than the author quoted, that fixed battle dressing stations be abolished should be critically examined.

In favor of portable outfits and the setting up of the stations at sites to be selected after battle in the manner suggested are:

(*a*) The assumed greater probability that a number of small portable outfits scattered throughout the ship would escape destruction than that fixed battle dressing stations would so escape.

(*b*) The assurance of great flexibility and mobility of the medical department.

(*c*) The ease with which stocks of dressings and other surgical material may be concentrated at places chosen for setting up the dressing stations.

(*d*) Adequate space, off main arterial routes accessible to both ends of the ship may be found on the second deck or above while crowded conditions and general inaccessibility of present dressing stations render them worthless.

In favor of battle dressing stations as at present provided are:

(*a*) The locations are known to the crew and with well-marked access routes, ambulant patients may promptly report for treatment.

(*b*) Ample dressings, operating facilities and water reserve are localized.

(*c*) Manifest provision for care of wounded will support morale and tend to promote efficiency.

(*d*) Protected by armor (on major ships), unless the vessel suffer excessive damage, at least one station will probably remain fit for use.

It is believed that:

(*a*) Prompt and effective treatment may best be achieved by planned rather than extemporized facilities.

(*b*) The value of permanently located battle dressing stations has been clearly demonstrated in modern naval warfare.

(*c*) Interludes in battle may permit access to these stations where wounds may be treated, effectives restored to duty, and lives saved. This will be facilitated if the slightly wounded and the stretcher

bearers know precisely where medical officers will be found and how to reach them by established clearly blazed routes.

The record of British ships at Jutland would seem to fully justify the existence of battle dressing stations—in fact there would seem to have arisen no doubt in the minds of their medical officers as to their efficacy. From descriptions given they were no more accessible and certainly no better equipped than those in our own Navy.

In any event it has been decreed that on new major ship construction battle dressing stations, with adequate storerooms at the forward and after stations and locker space amidships shall be provided and that they shall be retained on ships now in being; that on cruisers two stations with sufficient locker space shall be provided. This decision has been made by the Chief of Naval Operations on the recommendation of the Commander in Chief, Bureau of Construction and Repair and the Bureau of Medicine and Surgery.

Additional dressing station facilities.—While permanent battle dressing stations are considered essential, to provide against the destruction of one or more of them, by joint action of the Bureaus of Construction and Repair and Medicine and Surgery there is being developed, along the line of the postulates prescribed by Jensen, a portable locker-type outfit to contain sufficient material for setting up one or more dressing stations in such spaces as may be found suitable. The present intention is to provide about six such lockers for battleships and a proportionate number for cruisers. It is also the intention to place one such locker in a convenient place upon each new destroyer.

While battleships only have been considered in discussion of battle dressing stations, quite similar arrangements are provided on aircraft carriers. On cruisers such deviation from the principles enunciated as exist are based upon lack of protection by armor and comparative crowding of general facilities. Since armor protection is not available the sick-bay area is the best possible battle dressing space. Because deck space is at such a premium, officers' or chief petty officers' pantries and living spaces are generally utilized for the other station. Such fixtures as reserve water tanks, water heaters, and lockers are installed in these areas as may be required. On destroyers, in suitable locations, at each end of the ship, water heaters and outlets for a small sterilizer are provided. It is assumed that on these vessels the wardroom will be used as a battle dressing station; the fittings in crew spaces are provided in event of the officers' country being rendered unusable.

Battle station facilities.

(*a*) First aid lockers have been sufficiently considered.

(*b*) Water should be provided for drinking. Should the battle be prolonged all hands will probably need it, but particularly will the wounded demand it. Canteens will hold a sufficient quantity;

however, a 10-gallon container with faucet and hooks for hanging it upon a bulkhead is being considered. The additional weight and demand for storage space may prevent its adoption.

(*c*) A sanitary stool, capable of being lashed down, has also recently received consideration, but again weight and storage problems will probably debar it. In any event buckets provided for this purpose should be lined with impervious paper, to be immediately thrown overboard after use. The Bureau of Construction and Repair has given attention to production of a type of lining to fit the regulation Navy bucket. Necessity of guarding battle stations from gross contamination require no comment.

(*d*) Protective clothing and gas masks are not the responsibility of the medical officer; but, as all preventive measures against disease and injury are within his province to the extent that appropriate recommendations are to be made by him if occasion demands, observation as to adequacy and cooperation in maintenance of efficiency of these items should not be neglected.

FLEET MEDICINE

By Capt. George F. Cottle, Medical Corps, United States Navy

Fleet medicine is founded on the need to liberate medical activity through cooperation, to strengthen it by coordination, to harmonize it with naval administration, to fit it to the requirements of naval tactics and to make it contribute to the success of naval strategy. It seeks to interpret medical principles to naval commanders and to explain naval requirements to medical personnel. It is practiced through inspections, through study of problems, through conferences, and through indoctrination. It attempts to lessen the number of casualties due to disease and accident, to build positive health and vigor in naval personnel, to enhance morale and to find how to select persons able to stand the stress and strain of naval warfare.

Fleet medicine deals with ships, divisions, squadrons, flotillas, and forces. It includes preventive medicine, emergency medicine, hospitalization, and medical logistics. It encompasses aviation, submarine, and field medicine. It provides for medical disaster relief and for the care of war time casualties. It studies the causes of fleet morbidities and mortalities. It considers diet, food, clothing, bedding, living conditions, work schedules, athletics, and recreation. It takes into consideration safety devices, safety mechanisms, and habits. It studies the ebb and flow of quarantinable and other communicable diseases in the ports visited by the units of the fleet. It is interested in hygiene, sanitation, quarantine, and pratique. It is interested in immunology and epidemiology, in liaison with health departments and with medical activities ashore. It is interested in the distribution of

medical personnel, in the environment provided for medical personnel at sea, in the sufficiency and economy of medical supplies and equipment. Fleet medicine strives to study medical problems, to give timely information on medical matters, and to be prepared to provide consultation when indicated.

From the day when lime juice pushed scurvy off the sea to the day when a few tablets of common salt stopped the incidence of heat cramps in fire rooms, fleet medicine has year by year seen morbidities and mortalities reduced and eliminated. The seven quarantinable diseases, including smallpox, yellow fever, and cholera no longer enter the Navy because fleet medicine has long been coordinated with the activities of the United States Public Health Service through whose activity those diseases are kept at bay. Typhoid fever has been almost eliminated by inoculation, dysentery by precautions surrounding the supply of drinking water and food in ships. Attention to safety precautions and devices while men are at work, to living conditions aboard ship, to athletic and recreational opportunities have in combination with improved methods of control of the spread of disease, reduced morbidities and mortalities year by year and encouraged healthy, wholesome, normal, ambitious young men to enter the naval service and to remain in it.

Fleet medicine attempts to develop fleet medical sufficiency, the ability to meet the emergencies of surgery, of medicine, and of preventive medicine. It provides for intership consultations, for transfer of the sick and injured at sea. It hopes to so influence its ships' medical officers that the fleet, each force and even each ship will be able to complete its assigned task, perform its tactical mission without the disturbance that can be produced by inability to handle medical emergencies.

Fleet medicine attempts to visualize its war mission. It studies the history of naval warfare, the battle of Jutland, the overseas combined operations at Gallipoli, the history of transportation overseas of troops from Australia, Canada, India, and the United States. It realizes that sick lists in transports rise to 5 percent of all on board, that attempts to seize defended beaches result in 20–40 percent of casualties which must be evacuated along lines of naval communication without too great slowing of the military and naval advance. It discusses the movement of hospital ships, the preparation and placement of field hospitals. It takes cognizance of the professional ability of naval reserve medical personnel and prepares to give them an understanding of the seagoing environment in which they are expected to function.

Naval personnel at sea live within the iron walls of ships where workshops, enormous power plants, complicated machines, high-tension electricity, guns large and small, high explosives, airplanes,

small boats, tall masts, contain the threat of accident even of disaster. On deck, fog, rain, snow, sleet, storm, heat, and cold produce their effect. Inside the ship, officers and men eat, sleep, bathe, play, work, study, and drill crowded together too close for comfort. Fleet medicine is interested in the prevention of disease transmission, in the prevention of accidental injury. Closed tight against storm and wet or against enemy attack the ventilation, heating, and cooling of living and working spaces require study and supervision of a special sort.

Fleet medicine is interested in the medical care available to families of officers and men on shore. The better medical care available loved ones ashore the more free from worry and the more able a crew becomes for the work at sea.

Fleet medicine is interested in health conditions at and near shore bases and ports of call. The efficiency of public health officials ashore directly effects the health of the fleet. Fleet medicine learns of the incidence of world-wide disease through reports of the United States Public Health Service. It learns of local disease incidence through scanning the weekly and monthly reports of State, city, and county health boards. Thus it can anticipate, slow up, or perhaps even prevent sudden unexpected entry of epidemic disease to the fleet. Some of its problems can be solved by the receipt and dissemination of news, some by study and indoctrination, some are capable of solution in the fleet only in part, some wait upon solution of public health problems ashore, some must wait until new therapies, new preventives are found.

Nearly one-half of the total yearly incidence of disease and injury in the Navy is due to causes that are not directly within fleet or Navy control. Of the 55,614 primary admissions to sick list in the year 1936, 17,725 were due to communicable diseases transmissible by oral and nasal secretions the great majority of which were of the "common cold" or according to the Navy nomenclature "catarrhal fever"; 8,148 primary admissions to sick list were due to the venereal diseases and 802 were caused by accidents from vehicles.

The dangers of crowded living conditions are constant. Cleanliness of mess gear, of food handling, scuttle butts, clothing, persons, bedding, supervision of ventilation, of heating, of laundries, of barber shops; these and other hygienic mechanisms reduce somewhat the opportunity for rapid spread of many diseases but the common cold still sweeps unhindered through ships and fleets and influenza is still entrenched behind its power to fell large numbers of men and even to slay a few. Medical literature is scanned in vain to find a preventive of value against this foe to fleet efficiency, this invader which returns year after year to bother, and to disturb, to initiate, and to do damage.

Against the second common cause of fleet disease incidence, the venereal diseases, we have some useful weapons and of late some hope of better days ahead. To attempt control of these invaders we teach

and warn our men, we give them ready access to chemical and mechanical preventives. We improve our therapy as it improves in civil life. We are ever alert to find and use new remedies. We have achieved a degree of success. For 4 years the incidence of these diseases has been continuously lowered each year. Further reduction depends upon successful action in civil communities where these diseases ebb and flow practically uncontrolled. However, hope is here, civilian communities are awakening, out of the dark of defeatism a new day is dawning. The light of this new day has for 10 years been shining in the Scandinavian countries where the incidence of venereal disease has been falling, where syphilis has become a rarity. The light of this new day has penetrated to England. It has reached the Commonwealth of Massachusetts, the State of New York. Reflected from the brilliant service of Doctor Parran, the Surgeon General of the Public Health Service, it is spreading throughout the United States. The new light has begun to glow where inertia, ignorance, false piety, silence, let well enough alone policies have lived in darkness. Governors, legislators, cities, towns, and counties have taken notice. State boards of health have turned from discouragement to hope, old laws have been given new life, new laws have come into being. The people have begun to listen, to open their purses, to lend their support. Newspapers, periodicals, books, and people have become articulate. The battle is on in earnest, in the open. These age-old enemies must be and will be conquered when the citizens and physicians are stirred to act in line with public health leadership.

In 1936, 860 of our officers and men were striken on the public highways and 56 of them died from this cause. The fleet can exert but slight control over the hazards of the highway. Condemnation and punishment of offenders, in occasional instances, warning against carelessness, are the limits of our control, hope for reduction in these losses of man power lies only in civil life.

Fleet medicine is interested in human conduct, in the prevention of mental aberration and mental disease. Our aviation specialists tell us that there is a recognizable type that cannot take the stress of aviation. We feel that there is opportunity to study human behavior more intensively, to find and try out more exact measurements of psychic and emotional states among officers and men. Every year we see suicide, discharge from the service for mental disease, and discharge from the service for disciplinary reason. Fleet medicine faces this problem of the ability of human beings to become adjusted to naval life with the firm belief that some of these losses of man power originate in types that are emotionally unstable. It is believed that some of them can be discovered and eliminated from the service before their conflicts and maladjustments reach the tragic end of suicide,

mental disease, or disciplinary discharge. In statistical form the losses for the year 1936, from these causes were:

Suicides	29
Separated from service for mental disease	241
Separated from service by disciplinary discharge	919

The senior medical officer of a ship, the division medical officer of a group of destroyers sees fleet medicine from his station aboard one ship. He is absorbed in the care of the sick, in attempts to influence ship hygiene, to control the spread of disease, to save life and limb. In this outline of fleet medicine he may find a widening horizon. He may find a means to focus his attention on the unsolved problems that persist. He may find a way to lead us forward one more step toward reduction of the morbidities and mortalities not yet eliminated from the sea.

HOSPITAL SHIPS [1]

By Capt. Lucius W. Johnson, Medical Corps, United States Navy

Introduction

Down through the centuries there has been gradual development of a mental concept that has been aptly termed the Red Cross idea. This idea, briefly stated, is that adequate care for the sick and wounded of naval and military forces is not only good as a humanitarian act, but it is of distinct advantage to the organization. It prevents the spread of disease, restores men to the ranks who would otherwise be lost, and helps to maintain morale.

In remote times it was customary for military leaders to take with them to war, but only for their own personal service, men who combined the duties of barbers and surgeons. Their soldiers, when wounded or sick, were left to the tender mercies or the evil devices of the camp followers. Ambroise Pare, best of the early military surgeons, describes an impressive incident which occurred at Turin in 1563. He saw an old sergeant cut the throats of three of his wounded men, gently and without malice, remarking that he hoped somebody would do as much for him if he were ever in their condition. Numerous historical records leave us in no doubt that the lot of the wounded soldier of that day was not a happy one.

By the middle of the eighteenth century, most governments had begun to feel the obligation to protect the health of their soldiers and to organize for the care of the sick and wounded. As the general standards of medical and surgical care and hospital treatment have

[1] The conclusions reached and the opinions expressed are entirely those of the author. They must not be regarded as in any way representing the official opinions or administrative policies of any bureau or governmental department.

Editor's note.—The author is particularly competent to write on hospital ships. His service included duty as senior medical officer of a large troop transport and as senior medical officer on the U. S. S. *Relief*, and he has obviously made a thorough study of his subject. This article as submitted included an excellent historical review which the Bulletin was unable to use.

advanced through the decades, provisions for the care of men in the armed forces have made parallel progress. (1) We have it on the authority of no less a personage than Sir John Pringle that, in 1743, before the battle of Dettingen, the Earl of Stair proposed to the Duke of Noailles, of whose humanity he was well assured, that both the English and French hospitals should be considered as sanctuaries for the sick, and mutually protected. This was readily agreed to by the French general, who took the first opportunity to show a particular regard for this engagement, and it was strictly observed on both sides. The idea continued to spread and finally, through the persistent efforts of Mons. Henri Dunant, a Swiss, culminated in the Geneva convention of 1864. (2) A series of conferences and conventions at Geneva and The Hague followed, with The Hague convention of October 18, 1907, giving special consideration to the evacuation of the wounded in naval warfare, and to hospital ships, which is our present interest.

This recognition of hospital ships, and the clarification of their status, marked an important step in their evolution. It focussed the eyes of the military world on a matter that had been gradually taking form for centuries—floating hospitals for naval personnel.

Some of the most commendable of humanitarian ideas weave themselves so gradually into the fabric of human thought that their presence is not even suspected until long after they have become thoroughly incorporated into the pattern of community opinion. They are usually brought to the fore when somebody discovers that they are not only of philanthropic interest, but of great practical value. Thus the hospital idea germinated very gradually for more than 250 years and then burst into full bloom about the turn of the century, when the practical importance of conserving the lives of trained naval and military men began to be appreciated by governmental authorities.

We have made great advances since the days when the dead and seriously wounded in naval battles were thrown overboard, to avoid weakening the morale of those who continued to fight. The trail of our progress is marked by numerous publications dealing with hospital ships, and so extensive is the literature on the subject that more than 200 books and articles were read in assembling material for this dissertation. Two of them are of sufficient importance to deserve special mention.

Hidden away under the title "Medical Tactics in Naval Warfare" is the most complete and authoritative study of hospital ships and their employment that I have been able to find. In this book, which was published by Capt. W. L. Mann, Medical Corps, United States Navy, in 1926, there are 80 pages devoted to consideration of the subject of floating hospitals. His profound research and clear reasoning have produced a work which no student of this topic can afford to underestimate. It has been of the greatest assistance to me, and I

am reminded of a passage written by a distinguished professor of biology in the University of Cambridge. In the 1909 edition of Mendel's Principles of Heredity, Professor Bateson recounts an incident of his early years in research. "I well remember receiving from one of the most earnest of my seniors the friendly warning that it was a waste of time for me to study variation, for Darwin had swept the field." I have some hesitation in approaching the matter of hospital ships, where Mann has swept the field, but am encouraged to continue and to test the old adage that "fools rush in and win where angels fear to tread."

Surgeon-Rear Admiral Edward Sutton, R. N., is the author of the other outstanding book. It is entitled "The Fitting-Out and Administration of a Naval Hospital Ship," and was published in 1917. His experience in command of H. M. S. *Rewa* and H. M. S. *Drina* during the world war formed the background for this excellent work. In 1918 he was in command of the naval hospital at the navy yard, Haulbowline, Queenstown, Ireland, and the many medical officers of the United States Navy who made his acquaintance there have reason to remember with pleasure and gratitude his helpful and courteous demeanor.

There are also many important articles by Pickthorn, McNabb, Chambers, zur Verth, Pleadwell, Holcomb, Chastang, Averous, and others, which the student of this subject must not fail to read. They will be found listed among the references.

I am greatly indebted to the Army medical library for the loan of many books and periodicals which could not be found in any of the west coast libraries to which I had access. Particular thanks are due to Commander L. H. Roddis, Medical Corps, United States Navy, for tracking down many elusive references. This is being written during a 2-year cruise on the U. S. S. *Relief*, much of the time remote from sources of information. In such a case, one needs a friend who is familiar with the libraries where naval and medical history may be found. Dr. Roddis has been such a friend and has seldom failed to dig up the information that was needed.

A leading nation, engaged in a major naval war, will require several types of hospital ships, each differing from the others in certain important characteristics. There should be fleet hospital ships, floating hospitals for advanced bases, hospital transports, perhaps rescue ships and small craft for inland waterways. Each of these demands accentuation of certain details that are most important for the work that it is called upon to do.

We have examined, sometimes with a critical eye, the hospital ships of the past. It is with no disrespectful thought that we summon back those forgotten ships, to learn from them the secrets of their failures and successes, of their good and bad features, hoping to observe them

with that nicety of discrimination that will enable us to take profitable advantage of their virtues while avoiding their faults. A hospital ship, like every other human achievement, represents a series of compromises between the ideal and the practical. This point is emphasized by Mahan, in commenting on the design of combatant ships.

> You cannot have everything. If you attempt it, you will lose everything; by which I mean that in no one quality will your vessel be as efficient as if you had concentrated purpose on that one. On a given tonnage * * * there cannot be had the highest speed, and the heaviest battery, and the thickest armor, and the longest coal endurance, which the tonnage would allow to any one of these objects by itself.

This principle applies equally to hospital ships. You cannot have the highest speed, the greatest steadiness, the largest bed capacity, economy of operation, and the most efficient arrangement of medical department spaces, all combined to the maximum degree in any one ship, so compromises will be required to make the individual ship best fitted for its purpose.

I. The Fleet Hospital Ship

The fleet hospital ship should be, above all other things, a ship specially built for its intended function which is to accompany the fleet and provide it with hospital facilities. The hospital transports may well be converted liners, but the ship that is to serve as hospital for a fleet has requirements that cannot be completely met except by special construction. No one would expect a house or a factory on shore to be converted into an ideal hospital, for there would have to be many makeshift arrangements which would reduce its usefulness. Even more is this true of ships, and writers on hospital ships have repeatedly criticised their converted vessels, stating that the highest efficiency would never be reached until a specially designed and built ship was provided. Our experience with the *Relief*, the only hospital ship afloat that was designed and built especially for this purpose, indicates that the useful life of such a ship will be at least 30 years, and any first-class nation would find that the specially built hospital ship had paid large dividends, which would justify the money invested, long before its period of usefulness was ended.

Size is a very important consideration, which has been discussed by many writers and with very little agreement. But it is noticeable that, whereas before the World War most authorities recommended ships of 3,000 to 5,000 tons, recent writers advise ships of 8,000 to 10,000 tons. The disadvantages of oversize were clearly shown by the *France IV* (29,000 tons), the *Aquitania* and *Mauretania* (30,000 tons), and the *Britannic* (47,000 tons), which were employed during the Gallipoli campaign. They were too large to enter the harbors at Alexandria and Malta and their capacity was so great

(3,500 to 4,000 patients) that a full load of sick was not always available, resulting in uneconomical employment. Their daily consumption of coal and water was so enormous that it was difficult to supply their needs. The *Maine*, of the British fleet, and the *Relief*, of ours, have proved to be sufficient in capacity for the needs of the fleet in times of peace, and reasonably economical in cost of operation. They are both approximately 10,000-ton ships. In time of war, rapid evacuation by hospital transports and hospital facilities on shore at an advanced base would be necessary, in addition to the fleet hospital ship, if overcrowding were to be avoided. A large ship provides steadiness, which is valuable for the comfort of the patients, for surgical operations, and other procedures, and it is easier to bring patients aboard a large steady ship.

Capacity is closely related to size, and must always be considered as being very elastic, varying with the requirements of the moment. Recent hospital ships have accommodated one patient for each 20 to 40 tons and, if the requirement of 300 to 500 cubic feet of air space for each patient is met, this proportion cannot be greatly exceeded. It must always be borne in mind that the level of efficiency of medical care falls rapidly as the normal capacity is approached or exceeded. For this reason, prompt evacuation, before the hospital ship becomes overcrowded, is very important and will save lives.

Speed should be sufficient to enable the hospital ship to maintain her place with the train, and a few knots in addition. It would be highly desirable to give her speed enough to keep up with the fastest unit of the fleet, but this would entail such great sacrifice of capacity and cruising radius that it must be relinquished in favor of more essential features. High speed also entails increased vibration and greater unsteadiness in a seaway, both undesirable attributes for a hospital ship. None of those who have written on the use of hospital ships during the World War has mentioned high speed as being necessary while several have spoken of its disadvantages. Sutton makes the important comment that high speed, inasmuch as it implies greater cost, absorption of space and production of heat, larger crews, and increase of discomfort in bad weather, is undesirable, and war experience has shown it to be unnecessary. He regards a cruising speed of 10 or 12 knots, with an extra 3 or 4 for emergencies, as suitable for a hospital ship.

Ability to remain with the fleet includes the requirement that she be so constructed that she can darken ship at night and still maintain habitable conditions in wards, clinics, operating rooms, machinery, and living spaces. This condition cannot be completely obtained unless the ship be designed and built with this feature in mind. A very large part of her usefulness to the fleet is lost if she cannot remain with it by night as well as by day, and if she can darken ship

only with intolerable discomfort to patients and workers, it will quickly be reflected in the death rate on board.

Electric-power production should be greatly in excess of that apparently necessary at the time of construction of the ship. Countless new electrical gadgets of all sorts have been installed in the *Relief* since she was commissioned, and there is nothing to suggest that this flood of new devices will slacken in the future. Both alternating and direct currents will be necessary and outlets will be required in all wards, clinics, and rooms for such machines as portable electrocardiograph, short-wave diathermy, ophthalmoscope, radio, portable X-ray, vacuum cleaner, deck polisher, and others. An auxiliary lighting system, entirely independent of the main power plant and assuming the load automatically whenever the voltage drops below a certain level, will be an essential. It should supply the operating room, engine room, and bridge. In most other parts of the ship the necessary work can be carried on by lantern or flashlight if the main circuit fails.

Distilling capacity should be greatly in excess of that provided for other ships of similar size. Care of the sick requires much more fresh water than a similar number of well persons would need and a very large quantity will be consumed in the laundry, laboratory, and other activities. Baths and other outlets will be much more numerous than on ships of other types. The fleet hospital ship should be entirely independent of outside sources in the matter of fresh water.

The hospital spaces should be concentrated amidships. Clinics, offices, treatment rooms, laboratory, operating rooms, convalescent wards, and other activities in which patients do not spend their whole time, may well be located below the main deck. Wards for the sick should all be located on or above the main deck and should have open deck space immediately adjacent to them. This is one of the most essential features and should be the last to be sacrificed when compromises are necessary. Both open deck space and glassed-in solaria will be required and it is important that they be made as accessible as possible, so that patients can be wheeled out on deck without too much handling.

Throughout the parts of the ship which are devoted to hospital use, the ladders, elevators, passages, and doorways should be so designed that they give convenient passage to patients on hand or wheeled stretchers, in wheel chairs or on crutches. Wide doorways with low coamings are essential and should be installed wherever the naval constructor will allow them. Stairways, instead of ladders, will make going about much easier for convalescent patients.

Rooms for patients will need to be large enough and have doors wide enough so that a wheel stretcher can be brought inside the room and alongside the bed for transfer of the patient. A narrow door into

a small room requires a great deal of awkward handling of the patient between stretcher and bed, and this may be a very serious thing if the patient be severely wounded, in shock, or in a plaster cast. The height of rooms and wards should be 7½ to 8 feet, to allow for satisfactory ventilation. Air space of 300 to 500 cubic feet per patient is the present standard but, with more advanced air conditioning, it is probable that this amount may be reduced considerably and still maintain adequate aeration.

Laundry capacity should be very large. On the *Relief*, with 200 patients present, about 2,000 pounds of Medical Department linen are sent to the laundry each day. This activity, together with the galley, bake shop, butcher shop, blacksmith shop, morgue, and other spaces which are likely to give off wild heat, unpleasant noises, or undesirable odors, should be located well aft, where they will cause the least possible annoyance to patients. Boats, davits, and all gear associated with them should receive the most careful consideration. They are important for bringing patients aboard, and doubly important for rapid evacuation in case it becomes necessary to abandon ship. Public opinion will not easily be appeased if there is unnecessary loss of life among the patients, in case of a disaster to a hospital ship.

Elevators are essential equipment and separate ones are desirable for patients, provisions, baggage, and contagious cases. Elevator wells are to be completely enclosed, so as to make them as nearly noiseless as possible. Careful study is required to have the wards, clinics, and passageways so grouped that they will be most conveniently accessible from the main elevator which is to be used by patients.

Indirect lighting is most desirable for the wards, and separate reading lights are needed for the bunks. Lights near the deck, similar to those used in theaters, are required for night use by attendants. Outlets for attachment of individual radios, or head sets connected with a central receiving station will provide amusement for the patients and help to keep them contented. Some type of silent call system with a push button at each bunk and an annunciator in the nurse's office will be a necessary part of the equipment.

Entry ports should be constructed in the hull, at least one in each side, to permit easy entrance of patients. A gangway 60 inches wide will be found to aid greatly in the handling of patients on stretchers. Several cranes especially designed and fitted for hoisting-in patients will be necessary. Boats in large number are required, for it may be necessary to take aboard many patients from sinking ships or from those whose boats have been shot away. All possible provisions should be made for rapid reception of large numbers of patients or shipwrecked men.

A study of the records of the *Relief* for the past 16 years, giving consideration to the patient loads at different times of the year, in port and at sea, indicates that the following percentage distribution of beds in the different wards will be most satisfactory:

	Percent
Officers	3
Contagious and acute medicine	10
General medicine	9
Operative surgery	15
Traumatic surgery	15
Eye, ear, nose, and throat	7
Insane	1
Urological and skin	15
Convalescent wards	25
Total	100

Plans are to be prepared in advance for rapid shifting of patients and reassignment of beds in emergencies, such as epidemics of contagious disease, a large influx of badly burned men, or many suffering from exposure after shipwreck. These are among the everyday hazards of life at sea and they provide the best test of the efficiency of the organization and the ability of the staff of the hospital ship.

If suitable spaces are available, it will be found very advantageous to make special provisions for certain types of cases which need special care, such as the insane, tubercular, patients in plaster cases, those with cardiac and renal disorders and patients requiring skeletal traction. The most modern equipment is required for X-ray, electrocardiography, basal metabolism, bronchoscopy, physiotherapy, photography, cystoscopy, dental clinic, and laboratory. No attempt will be made here to list the individual items of equipment or supplies, because they will vary so much, according to the time and place of outfitting the ship and the stock that may be available. The most important thing is that they should be the articles best suited for the persons who are to use them. A library of recent medical books and periodicals is a very important adjunct.

A list of the work done on a hospital ship in active commission will undoubtedly bring to the mind of the interested reader many details which have not been mentioned here. The *Relief* provides the following figures for the first 10 months of the calendar year 1936:

Total patients hospitalized	2, 027
Total sick days	39, 903
Major operations	475
Eye, ear, nose, and throat operations	320
Eye, ear, nose, and throat treatments	2, 197
Total laboratory examinations	13, 949
X-ray examinations and treatments	2, 002
Dental examinations and treatments	5, 639
Dental plates, splints, and other devices made	341
Physiotherapy treatments	4, 366

These figures are for active service with the fleet, both at sea and in port, during peace times. In time of war we should anticipate greatly increased demands on the fleet hospital ship. Thousands of newly-recruited men will join the fleet and this will inevitably be followed by epidemics of contagious diseases, perhaps crippling the combatant ships unless the sick can be removed to the hospital ship. The new men will develop numerous physical weaknesses as a result of their new activities, and many of them will require hospitalization. Advanced bases will probably be established overseas, at places where there are no hospital facilities on shore, and so the fleet will become completely dependent on the hospital ship. Prolonged cruises are likely to occur, with the hospital ship accompanying as a part of the train. All these activities will add to the work load.

Shall female nurses be employed on the fleet hospital ship? In time of peace, their presence is desirable. They create an atmosphere more conducive to recovery and their presence ensures the maintenance of a higher level of nursing efficiency. In time of war, they will be needed on the hospital transports, but with the fleet hospital ship, accompanying the fleet on long cruises, or remaining for long periods at an advanced base, they might easily become a liability. A French writer, discussing this problem, refers to the many temperamental and sentimental episodes which occurred on his ship and concludes that, if female nurses are allowed on hospital ships, they should be not only physically sound, professionally able and morally strong, but also of very advanced age. The writer has much sympathy with his point of view. If provision is to be made for them, each nurse should have a separate room; there should be elaborate bathing and toilet facilities and also a space where they may launder and iron their clothing. Deck space, where they may relax and sun themselves in privacy, is an essential. One must not forget to arrange an interior route to the wards so that they can go back and forth between their quarters and their duties without being exposed to inclement weather.

Ample provision should be made for storerooms and large ones, centrally located, will be found better than numerous, scattered, small spaces which require more room, more time and more clerical work. There should be separate spaces for bulk medical stores and open stock for issue. The linen room should have plenty of shelf room and a very large table for sorting, also ample floor space, for this is one of the busiest places on the whole ship. It should be convenient to the laundry and to the wards. One should plan to carry a year's supply of medical stores and linen, for the ship may be away from sources of supply for indefinite periods and, in war times, it may be impossible to replenish stocks of essential items. Cold storage rooms should be ample in size and conveniently located. Special

compartments are required for cold storage of biological preparations, a large stock of which will be necessary to provide for prolonged absences from sources of supply, and for cold storage of the dead. A strong room for alcohol and narcotics will reduce administrative difficulties in their care and issue.

A tent hospital to be set up on shore when needed, is a valuable adjunct, for which many uses will be found. A disaster in an adjacent civil community, an expeditionary force landed on a foreign shore, an epidemic of contagious disease that overtaxes the facilities of the ship, or any other condition that requires additional hospital work on shore can well be served by a tent hospital carried by the ship. Plans should be laid to make it as independent of the ship as possible, in the matters of commissary, fresh water, personnel, and medical supplies.

Plenty of deck space, both open and covered, is a prime requisite. It is essential, both for their own health and for proper administration of the wards, that ambulant patients be kept out of the wards as much as possible during the day, so it should be made as easy as possible for them to get on deck and take advantage of the sunlight and fresh air. A comfortable recreation room, where the convalescent patients and the crew in their time off duty may read, write, and play games will aid greatly in maintaining morale.

Consideration should be given to the harmful effects of noise and the increased suffering which it may cause the sick. Soundproofing of the decks and bulkheads will help to reduce this. Cranes, winches, and other machines should be removed as far as possible from the spaces for the sick and every effort made to have the most silent type of machines installed in such a way as to reduce noise and vibration to the minimum.

Ratproofing, telephones, facilities for showing moving pictures, air conditioning of wards and rooms, equipment of galleys and diet kitchens, quiet rooms, plumbing fixtures, plaster room, venereal treatment room, bronchoscopic facilities, floor coverings, and canteen are a few more of the myriad details that must be considered when planning the construction or the conversion of a hospital ship.

In general, our aim should be to provide a vessel having all the facilities, all the equipment and the trained personnel of a completely modern shore hospital. In addition, it should carry a reserve of stores for issue to other ships, a field hospital to be set up on shore to serve an expeditionary force or to aid in case of disaster in the civilian community, and equipment for rescuing those who are required to abandon sinking ships.

Employment.—It is universally recognized that, in time of peace, the sole function of the fleet hospital ship is to provide a complete, mobile, base hospital for the fleet, whether in port or at sea. In

carrying out this function it helps combatant ships to avoid danger of epidemics by removing their cases of contagious disease. It provides facilities for disinfection, special laboratory work, consultation with recognized specialists, and care of the dead. It benefits the morale of fighting ships by removing their sick and wounded. Sir Cyprian Bridge, in the Art of Naval Warfare, recommends that the base hospital facilities be mobile, in the shape of hospital ships, rather than stationary on shore, which could not readily be expanded and would doubtless be too remote from the scene of battle. He also states that:

> The problem of expanding sufficiently the Medical Department of the Navy when war comes, will be most effectually solved by the employment of hospital ships in time of peace, provision being made for an increase of their number as soon as hostilities are imminent. Hospital ships steadily worked in peacetime will habituate the service to their use in war. This will go a long way toward rendering a fleet or squadron independent of fixed bases which it may be impossible to form except at inconveniently distant points. It will perhaps appear more costly than the plan of establishing Government hospitals at fixed bases; but in the first place this is not certain, and in the second place the excess of cost, if any, may be justifiably incurred, because it will be due to the adoption of a plan promising increased efficiency in war.

These are the benefits which flow from the employment of hospital ships with the fleet in time of peace, as the *Relief* is now employed.

In time of war, the functions of the fleet hospital ship will be considerably expanded. Not only will she provide hospital facilities while the vessels remain in port but when the fleet, or an expeditionary force, goes to establish an advanced base, she will accompany them, to provide the necessary establishment for the care of the sick and wounded at that base. When the fleet moves on to another base the hospital ship will accompany the train, perhaps leaving behind, in the field hospital set up on shore, those unable to resume duty, for return to the home bases by the hospital transports. Practically all writers agree that, like the other auxiliaries, the hospital ship has no place with the fleet during battle or when it is imminent. Mahan writes that the proper disposition of the transports and hospital ships, until the end of the battle, is to dismiss them out of mind and presence. If beaten, the loss of them will not be of the slightest consequence; if successful, they can be summoned from an appointed rendezvous. Before and after the engagement, however, the hospital ship may play her most important role.

When contact with the enemy force impends, all disabled men should be cleared from the combatant ships. This will save such men from the discomforts and anxiety they would suffer as nonparticipants in the midst of the battle; it will improve the morale of those left to fight; it will make the whole hospital space of the ship available for the injured after the battle.

The battle being over, every effort will be made to remove the disabled from the fighting ships as quickly as possible, and this in-

volves the consideration of a multitude of varying conditions, such as rough or smooth sea, the distance of the fleet from the base, presence or absence of enemy submarines, decisive or indecisive outcome of the battle, victory or defeat for our fleet, number of wounded, and the number of seaworthy boats left for their trans-shipment. It may be advisable for the hospital ship to proceed and join the fleet; or for both to proceed to the base before transferring the patients; or to send medical officers and supplies from the hospital ship to the surviving ships to aid in the work, instead of bringing the patients to the hospital ship. No rules for this work can be laid down in advance because of the myriad conditions that may influence the choice of the means to be adopted.

Arrangements for loading and unloading patients deserve long study. No completely satisfactory method or device has yet been developed. Ever since the Battle of Beachy Head in June 1690, the importance of this problem has been recognized and dozens of schemes have been tried, but no completely satisfactory method or device has been developed. When the *Relief* was built, an elaborate apparatus was installed for hoisting patients aboard; but its use was abandoned, and it was eventually removed because it worked too slowly and it failed to raise the two ends of the stretcher at the same rate of speed. At present we are using a very simple means; a davit is swung out and from it a twofold fall is dropped. At its lower end are four finger ropes, each with a snatch hook at its end. The hooks are secured to the four corners of the Stokes stretcher, and it is then hoisted in by hand. The Stokes splint stretcher has been the Navy's standard for more than 25 years, and it is still regarded as the best for moving disabled men.

Transportation of patients from ship to ship at sea is best accomplished by using a motor whale boat and putting the patient in it before lowering. When patients are received from or discharged to a dock or a lighter alongside, cradles carrying two or more stretchers may be employed. Countless devices have been tried, but still there is no satisfactory means of transferring wounded men from ship to ship in a rough sea. This fact, and the possible presence of enemy submarines, impose the most important limitations on the usefulness of the fleet hospital ship after a battle. Mann has suggested that over-age destroyers be fitted out for the work of carrying patients from combatant ships to the hospital ship, and that they accompany the fleet for this purpose.

II. Fleet Hospital Ship, United States Ship "Relief"

This is the only hospital ship maintained permanently with a fleet in time of peace. She is the only modern hospital ship to be designed and built, from the keel up, for this single purpose. Since her recent extensive overhaul, she represents the most advanced ideas in hos-

pital ship arrangement and equipment. For these reasons, considerable space will be devoted to a detailed description.

The sentiment has often been expressed by those writing of hospital ships, that a vessel designed for carrying cargo or passengers had many limitations when the time came to convert her to care for the sick. Even the most costly and extensive alterations produced a result far from ideal. Many have wished for the opportunity to design and build a hospital ship which should approach perfection. The United States Navy finally did build such a vessel, and it was the happy lot of Commanders E. M. Blackwell and R. C. Holcomb, of the Medical Corps of the Navy, to put their dreams on paper and to see them transformed at last into the substance of the U. S. S. *Relief*.

The present ship was named for the earlier *Relief*, a converted liner which served the same purpose during the Spanish-American War, the Philippine Insurrection, and the Boxer uprising. On August 29, 1916, the act of Congress which authorized the construction of the new hospital ship was passed and, on the same day, the contract was awarded to the Philadelphia Navy Yard for the construction. While the World War continued, other building was considered more important and the work on the *Relief* lagged. The keel was laid on July 14, 1917; the first frame was erected on May 15, 1918, and she was launched on December 23, 1918. Mrs. William C. Braisted, wife of the Surgeon General of the Navy, was her sponsor. On December 28, 1920, she was finally commissioned.

The hull of the *Relief* is built on the standard naval-auxiliary plans and it is 484 feet over all, 61 feet beam, 20 feet 6 inches draft, and 9,750 tons full-load displacement. The twin screws are driven by Parsons-type geared steam turbines of 5,000 horsepower. The steam used by these turbines is generated by three Babcock and Wilcox, oil-burning boilers, which have a capacity of 5,500 horsepower. The extra 500 horsepower generated by the boilers is used to run the auxiliary machinery, such as the two 300-kw generators, steam pumps for various uses, galley, laundry, heating circuits, sterilizers and evaporators.

There is an auxiliary lighting system for the operating room, two dressing rooms, engine and fire room. When the generators fail, or the voltage drops, it switches automatically to the 300-ampere batteries, which are sufficient for 6 to 8 hours at 120 volts. In addition, there is a generator driven by a Kohler four-cylinder gasoline engine, which is sufficient to light these same spaces for an indefinite time. A 40-kv-a steam-turbine driven generator furnishes alternating current electricity for the X-ray machines, radios, and short-wave therapy machines. This arrangement is not as satisfactory as a large rotary converter would be. Installation of additional electrical devices from year to year has taxed the capacity of the generators to the limit, and

this suggests that generous provision for such expansion should be made when planning hospital ships.

Two passenger and two freight elevators are provided. The main elevator runs through all decks from the medical storeroom in the hold to the superstructure deck. It serves the convalescent mess hall, the medical and surgical wards, the operating room, sick officers' quarters, and the cabins on the superstructure deck. Its rated capacity is 3,500 pounds and it is large enough to accommodate wheeled stretchers, food carts, and other vehicles. A second passenger elevator connects the contagious wards with the main deck, so that patients can be admitted directly to those wards. A freight elevator, of 2,500 pounds capacity, runs from the main deck down to the cold-storage spaces and the morgue. An additional lift for baggage runs from the main deck down to the bag room.

The ship has four decks in the hull, including the hold; two above and two below the water line. There are four decks above the hull, including the bridge deck. The spaces on the respective decks, which relate to the Medical Department, are as follows:

On the superstructure deck, from forward aft, are quarters for the executive and senior medical officers, the commanding officer, 6 line officers, and the quarters for 12 nurses. On the extreme after part of this deck, four sets of officers' quarters have recently been constructed, to provide for two more medical officers, one dental and one line officer.

On the upper deck are located the operating suite, the sick officers' quarters with 9 rooms and the wardroom, with quarters for 11 staff officers. Then comes a well which is 6 to 12 feet in width, separating the main superstructure from the contagious wards. Abaft these are a locked ward with four beds and then the animal house. The last provides cages for white mice and guinea pigs.

The main deck has, under the forecastle, carpenter and paint shops, canteen, crew's recreation room, barber shop, seamen's quarters, and ship's service store. Abaft this comes the quarter-deck, 30 feet fore and aft. Here are the hatches leading to the wards below, and a cargo hatch leading to the medical store room. Then comes the dental clinic, running athwartship, with the X-ray clinic on the port, and the eye, ear, nose, and throat clinic on the starboard side. Abaft these are the medical record office, dispensary, galleys, and various ship's offices. Then comes the well which separates the contagious wards from other parts of the superstructure. In the after deck house we find a ward with eight bunks and three quiet rooms, which is used for the overflow from the contagious wards or from sick officers' quarters. Then comes the laboratory, the autopsy and embalming room, the large steam disinfectors, and the incinerator. Covered deck space, about 15 feet wide, extends from the quarter-deck to the stern on each side of the superstructure, on the upper and main decks.

The second deck, which is the first deck within the hull, is devoted largely to the wards. Under the forecastle are quarters for the hospital corps men and the crew. Then come 2 wards with 29 bunks and 1 quiet room in each. On the starboard side is the medical ward and on the port side is the eye, ear, nose, and throat ward. Abaft there is an athwartship passage, with a cargo port in each side of the ship for reception of patients. Doors in the after bulkhead of this passageway give access to the 2 large surgical wards of 60 beds each, on the port side for operative surgery and on the starboard for traumatic surgery. Along the wing passages outboard of the engine-room uptake are, on the port side, the physiotherapy clinic, scullery, and messroom; on the starboard side, the cystoscopic room, special diet kitchen, and post office. Abaft this, on the port side, is the urological ward.

The first platform has quarters for crew and hospital corpsmen, 2 convalescent wards with 56 and 64 bunks, mess room for hospital corpsmen and convalescent patients, bag room, laundry, and refrigerating space.

The second platform has a large storeroom for medical department supplies in bulk, 33 feet fore and aft, and extending the full width of the ship. There is a second storeroom, nearly as large, used as an issue room. Then comes a large space used for storage of patients' baggage. Abaft the engineroom bulkhead are rooms for storage and handling of linen, also large cold-storage spaces.

Certain of these compartments have features which deserve special mention for various reasons. They will be considered in the same order that they have appeared in the preceding paragraphs. The comments are not to be considered as criticisms reflecting unfavorably on those who have had to do with the designing, construction, or alterations of the ship. It is now more than 20 years since the plans of the *Relief* were approved and, during that time, there have been many changes in the requirements of hospital ships. The relative importance of many of the characteristics has altered. Details which were considered to be of paramount importance in earlier days have dwindled, while new developments, then unthought of, have made necessary many adjustments. I purpose to emphasize the good and bad points of the ship, and thus provide a useful guide for those who may be called upon to design and build similar structures.

The nurses' quarters are inadequate. They are placed two in a room, which is unsatisfactory. Privacy is a matter of small moment to most men, but to women it is predominant. The size of the room is of less importance than the fact that each nurse should have a room to herself. There is no way by which the nurses can descend to the wards without going out on deck and down an exposed ladder. The wet garments which result are uncomfortable during the hours of duty and

also endanger their health. In spite of these defects, they consider duty on the hospital ship as desirable and appear to enjoy it. Their presence on the ship certainly maintains the standard of nursing at a higher level and I feel that none of us would want to run a hospital of this nature, where patients remain for long periods, without them.

The operating suite fits its purpose admirably, but space is wasted which could be better employed. The operating room is 17 feet fore and aft, and 45 feet from side to side. The height is 13.5 feet. There are 75 deadlights, 18 inches in diameter, to provide natural light. These are fitted with shades and inner glass sashes to control light and dust. Two operating tables with Operay lights overhead are fixed, one on each side, and a third may be placed in the center line if needed. There are tile decks throughout the suite. The equipment is complete in every imaginable detail.

From the outside, the operating room structure gives the ship an unconventional appearance and navigators complain that, when coming alongside a dock with a wind blowing, it acts as a sail. This provides an excellent alibi for a poor landing. Natural light, for which such elaborate provision was made, is now entirely disregarded and the deadlights have been painted over to make them opaque during darken-ship maneuvers. The inner shades and sashes were controlled by a mechanism so elaborate that it was constantly out of repair. They are now drawn and fixed. The height is greater than necessary, though it undoubtedly aids proper ventilation and makes it more comfortable for the surgeons. I believe that it would be better to place the operating suite below the main deck, amidships, where the motion of the ship would be at a minimum, and that two separate rooms, about 12 by 15 feet each, would be better than the one large space.

Accessory areas in the operating suite are the scrub room, 11.5 by 10 feet; sterilizer room, 10.5 by 15 feet; etherizing room, 11.5 by 10 feet, and linen-room, 10.5 by 15 feet. A central fore-and-aft passageway gives access to all the spaces. The most important change in this area since construction of the ship is the installation of a shower bath for the use of the surgeons. Considered a dangerous fixture for an operating suite at that time, it required 16 years of intermittent effort to secure this very important detail.

The sick officers' quarters have a central lounging space and mess-room, 18 feet fore-and-aft by 17 feet athwartship. Outboard of this are, on the port side, 5 rooms and the toilet facilities; on the starboard side, 4 rooms and the office of the chief nurse. The forward room on the starboard side has its own toilet and bath, being two rooms converted into one for high-ranking officers. At the forward end is the main elevator and, in the after part, is the pantry. The latter is fitted with electric refrigerator and electric range. A dumb-waiter

formerly ran from this pantry down to the passageway abaft the galleys on the deck below. About 1926, this dumb-waiter was removed because it was inconveniently placed and the mechanism was so frequently out of order. The rooms average 10 by 8 feet 8 inches, with doorways only 30 inches wide. This makes it impossible to bring a patient into the room on a wheeled stretcher, so a great deal of awkward handling is necessary in getting a helpless patient in or out. The rooms are fitted with iron beds, 30 inches wide, having sliding sides like a baby's crib.

The contagious area consists of 5 separate wards. The forward one runs athwartship and is fitted for 22 bunks. On the starboard side is an 18-bed ward, while on the port side are 8-bed, 4-bed, and 2-bed wards. The diet kitchen is equipped, like those of all the wards, with electric refrigerator, electric stove, and running water. It also has a large utensil sterilizer for dishes and other gear.

When the ship was designed it was intended that access to the contagious wards should be only by the special elevator, which runs from the main deck. But, about the time she went in commission, a bridge was constructed at the level of the upper deck, which gives access to those wards. Many modern contagious-disease hospitals no longer segregate such diseases in different wards. They may be safely placed in adjacent beds, and with proper screening and precautions on the part of the attendants, no more cross-infection will occur than if they were in different wards. So the elaborate precautions that were taken to isolate this entire area from the rest of the ship are no longer considered necessary.

The forward ward, running athwartship, is usually used for pneumonia and other respiratory infectious diseases. The four-bed ward is mostly occupied by sporadic cases of cerebrospinal fever. This leaves three wards for the other exanthemata, and when we have four or five such diseases, it constitutes a very lively problem. It would be much better for a hospital ship which serves a fleet as large as this, to have more space for contagious diseases. In suitable weather, the wide decks outside the wards may have a dozen or more patients on cots, the overflow from the wards.

The locked ward has four bunks, two of them within an inner space which is separated from the other two bunks by a heavy wire-mesh partition and a door which also locks. Thus violent patients can be separated from each other. This ward has its own toilet and wash basin. A watch is constantly maintained when there are patients in this ward, and the man on watch remains at all times in the ward. He is provided with a whistle and there is a button on the bulkhead which rings a loud gong outside, for use if help is needed.

The X-ray, dental, and eye, ear, nose, and throat clinics are grouped on the main deck, with separate entrances so that out-patients can

be treated without entering the ward areas. The laboratory was originally located here, but the clinics proved too small for the work they were called upon to do, which has increased from year to year. So the laboratory was moved and the clinic space rearranged in 1935.

The dental clinic has four cubicles, each containing a standard navy dental chair and other equipment. One of them has a modern shock-proof X-ray outfit. There is also a prosthetic laboratory with complete stock of everything necessary for making plates, crowns, bridges, splints, and inlays. Until very recently, the hospital ship provided prosthetic service for the entire fleet. The eye, ear, nose, and throat clinic is located on the starboard side, and is divided into two compartments. The forward one, 24 feet long, is used for eye examinations. The after room, 14 by 18 feet, has a tile deck and is used for operative and bronchoscopic work.

The X-ray clinic has a main radiographic room, 14 by 16 feet, in which the apparatus is installed. The walls, floor, and overhead are lead lined. Forward of this are the viewing room and the dark room. New types of apparatus, developed since the ship was commissioned, have been installed and so the space is quite crowded. In designing a hospital ship, allowance of space must always be made for new devices that will be evolved during the life of the ship.

A ward with 11 bunks and 4 quiet rooms is located aft on the main deck, and is used for the overflow from the contagious wards or from the sick officers' quarters. One of the quiet rooms contains the installation for electrocardiographic and basal metabolism estimations.

The laboratory was moved from its former position to its present location, well aft on the main deck. It is 12 by 30 feet, and has a tiled annexe, 5 by 9 feet which contains the still, and a refrigerator for the emergency stock of biologicals. The furniture for the laboratory was designed and built for this space and is very satisfactory. It is equipped to perform all the tests required of a public-health laboratory in a large city, in addition to many purely naval requirements.

The autopsy and embalming room, adjacent to the laboratory, is a tiled compartment, 9 by 16 feet. The table is of the pedestal type, with slate top. Since this room is seldom needed for its designed use, it serves as an adjunct to the laboratory.

The two large steam disinfectors are of the Kinyoun-Francis type. A soiled linen chute on the port side leads down to them from the contagious wards above. After disinfection, the articles are removed from the starboard side.

One of the two large wards on the second deck was originally designed for a medical ward, but the great amount of traumatic surgery, largely due to motor-vehicle accidents, has made it necessary to employ both of these large wards for surgery. A smaller, 30-bed ward suffices for medical cases. The surgical ward on the port side has a

tiled room, 10 by 16 feet, which is used for dressings or for minor operations. On the starboard side, a room, 8 by 16 feet, is used for a plaster room, and is fitted with the latest type of fracture table.

The physiotherapy clinic is equipped with several types of lights and diathermy machines, and a tub for continuous baths.

The two large medical storerooms are a source of constant joy and, since it is the policy to carry at all times a 2-year supply of all Medical Department supplies and equipment, we are fortunate to have so much storage space. In the forward storeroom is a complete 50-bed tent hospital, with all necessary articles, ready to be put ashore for duty with an expeditionary force, or to give aid in a civil disaster. In the after storeroom is a steel locker, 6 by 10 feet, which is used for alcohol, narcotics, and dental gold.

Throughout the ship, the wards are fitted with pipe-frame bunks hung on vertical stanchions. The hooks on the stanchions are so arranged that either one or two bunks may be rigged. The single bunk hangs 33 inches from the deck, the same height as the standard hospital bed. When two bunks are in place, the lower one is 18 inches and the upper 55 inches from the deck. Nursing care is very awkward with the double-bunk arrangement, so this is reserved for use with convalescent patients.

The patient capacity of the *Relief* is:

Sick officers' quarters	9	Urological and skin	40
Contagious	52	Convalescent wards	120
Eye, ear, nose and throat	30	Overflow ward	8
General medical	30		
Operative surgery	60	Total	409
Traumatic surgery	60		

When an emergency demands more beds, there are folding cots and hammocks which can be used to bring the capacity to 500 or more. Ordinarily, only about 300 bunks are kept rigged, since nursing is more conveniently done with only one bunk rigged on the stanchions.

The capacity of the ship has always been adequate, and the proportion of bunks assigned to the different services is about correct. Occasionally, during the first 3 months of the year, contagious diseases provide more patients than there are bunks in the isolation wards. This temporary demand is met by combining other groups of patients, so that another ward is made available for contagious patients.

Messing is on the cafeteria plan. Each man takes a tray with plate, bowl, and cup, and passes along a counter on which are the food containers set in a steam table. He indicates which articles of food he desires and they are served to him by the mess cook behind the counter. He then sits down at a table, on which are bread, butter, coffee, condiments, dessert, and other special items. This system has

proved most satisfactory since it provides hot food in just the quantity desired, and reduces waste. Mess rooms for the deck force and the engineer's force are located aft on the second deck. Convalescent patients and men of the hospital corps are fed in the convalescent mess hall. Cripples are sent down by the elevator in advance of others. Bed patients are served with trays, which are prepared in the diet kitchens.

Each ward has three lighting systems: Ceiling lights for general illumination, night lights placed near the deck and portable utility or reading lights, attached to outlets near each bunk.

A general antenna system has recently been installed, with outlets in wards and rooms, where individual radios may be plugged in.

There are 27 different ventilation systems, with blowers which pass the air over steam pipes for heating. Several spaces, such as the special diet kitchen, sterilizer room and laundry, have exhaust blowers, recently installed, to ameliorate conditions of excessive heat. In the wards there are supply louvers overhead and exhaust openings near the deck. Heads and diet kitchens have exhaust ventilation only.

In the *Relief*, as in other hospital ships, a number of pet gadgets were installed at considerable cost which have proved of little utility. Just forward of the boiler room is a space 18 by 35 feet and 14 feet high, in which it was planned to place a gyroscopic stabilizer to reduce the amplitude of the ship's motion in rough weather. The stabilizer was never installed, but this 7,820 cubic feet of space remains unused, because the requirements of water-tight integrity will not permit the necessary openings to be made for access to it. There is little need for a stabilizer, for she is a very steady ship, and also she is reputed to be a very lucky ship as regards rough weather. I know of only one occasion, off New Zealand, in 1925, when she encountered a storm severe enough to interfere with her normal work.

There was also an elaborate vacuum-cleaning system, with four sets of motor-driven exhausters and piping running to outlets throughout the ship. It had 15 sets of vacuum-cleaning tools, thirty-five 50-foot vacuum hoses, and 35 hose-and-tool lockers. For a number of years it had been out of use and, in 1935, the machinery and a large part of the piping were removed. It seems probable that it was too complicated and had too many accessories to get lost and to wear out, and so it fell into disuse after the first enthusiasm faded. The modern portable electric vacuum cleaner has proven far superior to this system.

A very complete and costly hydrotherapeutic equipment was also provided. This was later removed because it required more fresh water than the distilling capacity of the ship. Salt water could not be used because the ship remains, for a large part of the year, in

harbors that are too heavily polluted for the water to be used in this way.

Swinging cots were also provided in some of the wards, with the idea that their motion would neutralize that of the ship. This is a most persistent delusion for, as far back as 1873, they were installed in Great Britain's hospital ship, *Victor Emanuel*, and I have read a recent article in which a theorist suggests their use in hospital ships. It is recorded that, in the *Victor Emanuel*, the swinging cots swung too much and the patients were thrown out on deck, and so the cots had to be fixed. On the *Relief* there was a similar experience. One has only to watch these cots swing, to understand why they fail. Their motion is governed by the law of the pendulum, but their oscillation period is not synchronous with that of the ship, and so, when a certain combined motion of the two occurs the swing of the cot is accentuated and the patient is violently ejected. One medical officer suggested that a gyroscopic stabilizer be installed in each swinging bunk, and perhaps that would be the best solution of the problem. The idea of swinging cots seem so plausible that we will surely see it proposed for future hospital ships, and other enthusiasts will rejoice that they have originated the wonderful project of swinging cots for the comfort of the sick on board ship.

But all the defects of the *Relief* have proved to be minor ones and most of them were easily corrected. She has served with complete satisfaction as the hospital for the fleet during 16 years and her material condition is such that she may well continue for as many years more. Those who had to do with her design and building may regard with complacency the success of their work.

Personnel.—Present allowance tables provide for 9 line officers, 10 medical officers, 3 dental officers, 2 supply officers, 1 chaplain, 7 warrant officers, 10 nurses, and 349 enlisted personnel, of which 124 are attached to the hospital corps.

During the year 1935 there were 1,814 patients hospitalized on the *Relief*, with a daily average of 110 patients and average sick days per patient 15.88. Three hundred and fifty-one were transferred to hospitals ashore; 1,237 returned to duty; 59 were returned to their ships to complete convalescence, and there were 17 deaths. Four hundred and eighty-one operations were performed in the main operating room and 417 in the eye, ear, nose, and throat clinic. There were 3,266 examinations and treatments in the eye, ear, nose, and throat clinic, 13,865 laboratory examinations and tests, 5,423 physiotherapy treatments, and 2,915 X-ray examinations and treatments.

In the San Pedro-Long Beach area there are no naval hospital facilities on shore, although a large number of navy ships are based there. The *Relief* acts as base hospital for these ships and spends

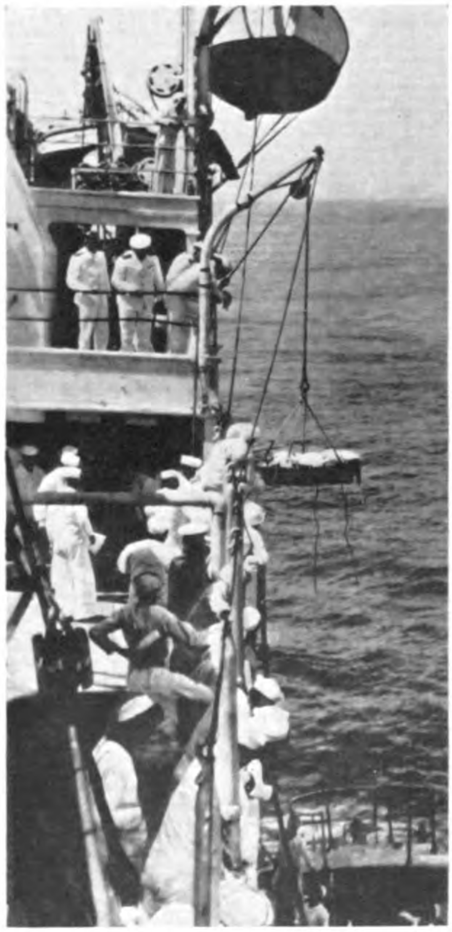
several months each year in this port. When the fleet goes on a cruise, the hospital ship accompanies it.

It is the policy to transfer to shore hospitals only those patients who will probably never return to duty or who, for climatic or other reasons, may be benefited by treatment in other hospitals. The *Relief* is equipped and staffed to offer definitive treatment for all conditions.

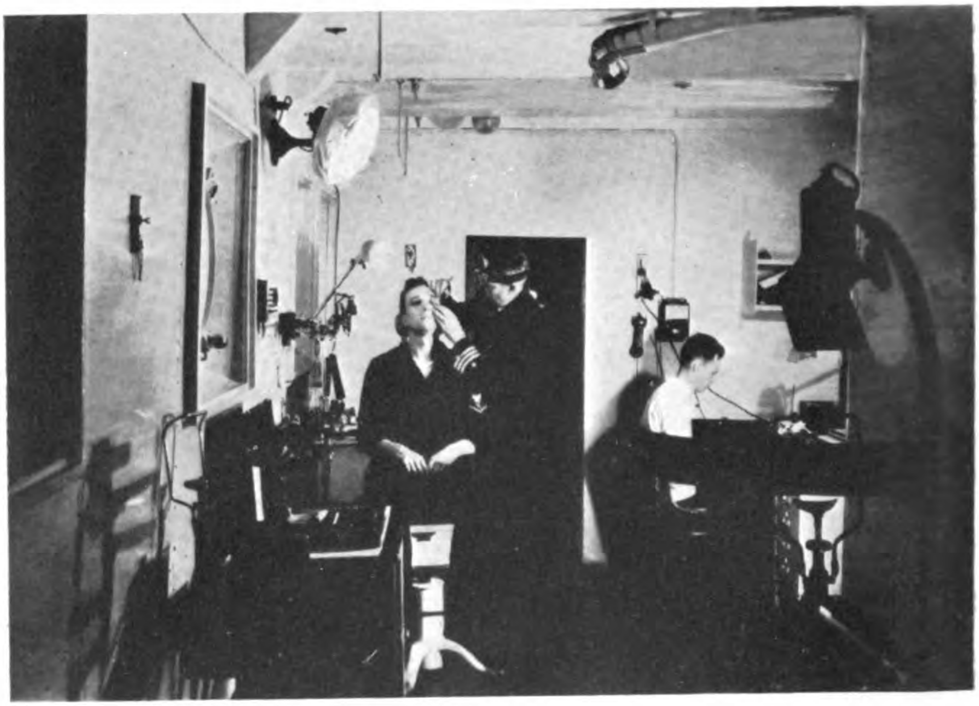
III. The Hospital Transport

The purpose of this chapter is to provide a guide for those who may be charged with the duty of converting merchant vessels into hospital ships. The experience of others shows that there are many details which greatly effect the efficiency and usefulness of the ship and may easily go unnoticed or receive scant consideration while the work is being done. It is only after the vessel is commissioned and has entered on her new duties that important defects appear, at a time when it is too late to correct them. Those who planned and carried out the alterations have seldom been present after the ship was commissioned, to learn of her faults, and so the same errors have been repeated over and over. Articles listing and commenting on the good and bad points of the individual vessels have usually appeared after the end of a war, at a time when everybody was too fed up with the whole thing to bother any more about details, and wanted only to be allowed to forget it. When the next war came along, the lessons of the old one were forgotten and nobody had time to look up the magazine articles and books in which those lessons were embalmed. So similar faults recur from war to war, with each complaining medico believing himself the first to be so plagued.

Those countries which have been far-sighted enough to plan intelligently in times of peace for the hospital ships needed when war comes were indeed wise and fortunate. Such planning has usually followed one of two lines. Arrangement was made with commercial steamship companies whereby certain of their ships would be delivered to the government immediately on the declaration of war. Complete plans of all necessary structural alterations were made, and the required equipment was assembled at the dockyard where the alterations were to be accomplished. The other plan involved a government subsidy at the time of building the ship. Compromises were made in hull design and arrangement of spaces, which would best fit her for the dual role of passenger liner in time of peace and hospital ship in time of war. The subsidy to the owners compensated for her faults as a commercial vessel and they agreed to deliver her to the government upon the outbreak of war. Both of these plans worked very well during the World War. But it happens in every large war, that governments, relief societies and other organizations are called upon to provide hospital ships without such previous arrangements.



HANDLING STRETCHER CASES.

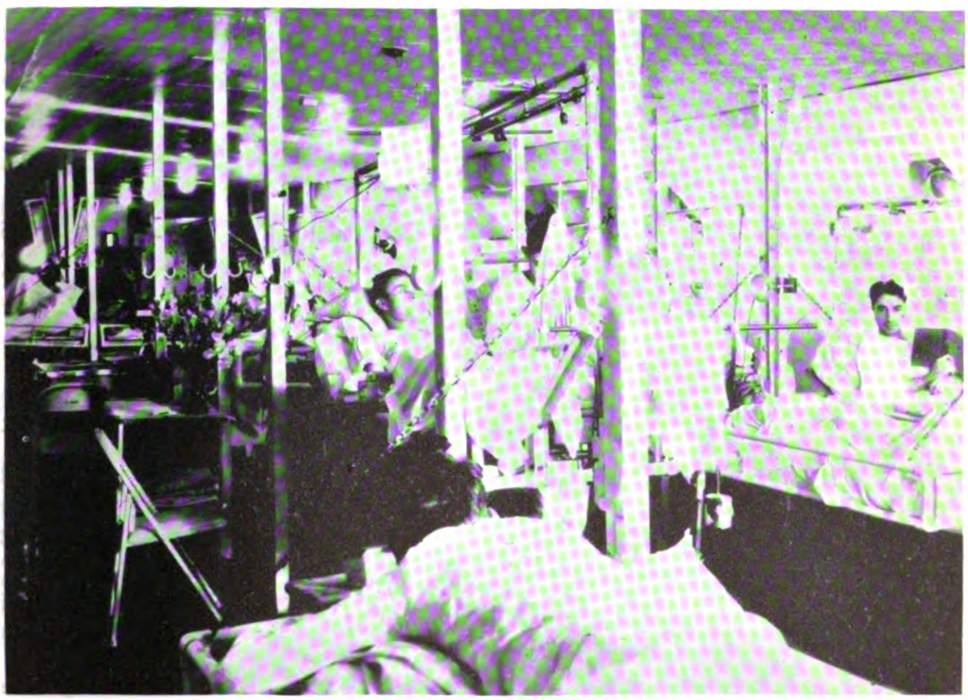


EYE CLINIC.

CLERICAL OFFICE.

218—2

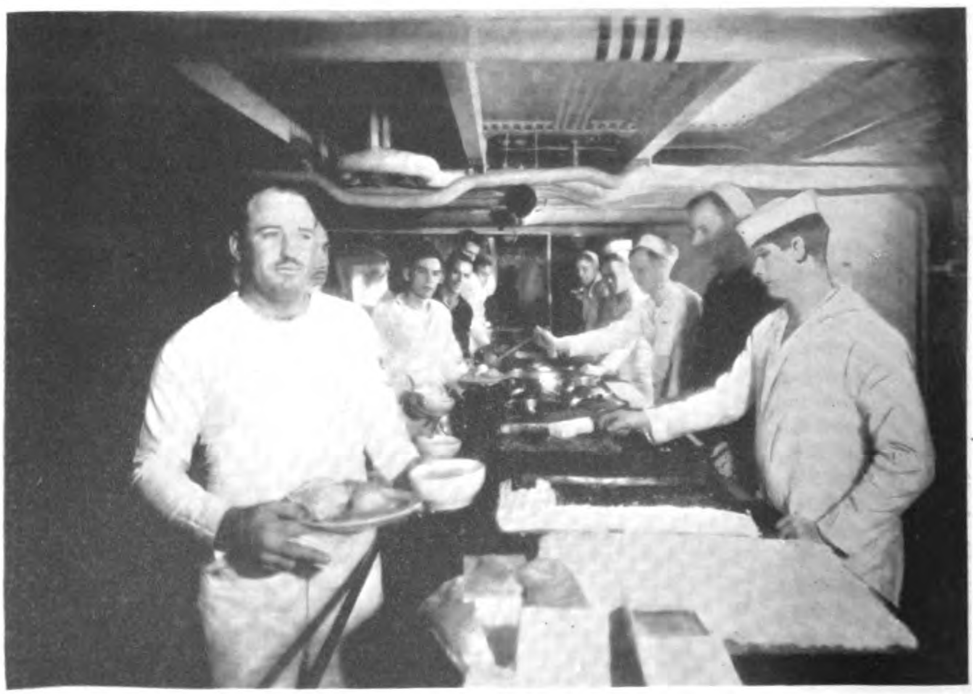
MEDICAL WARD.



SURGICAL WARD.

218—3

GALLEY.



GENERAL MESS.

The persons put in charge of the work are frequently inexperienced, some knowing little of ships, others unfamiliar with hospital requirements. My hope is to aid them to avoid the more serious blunders.

Before we can decide anything about the details of the hospital transport, we must know what work she will be called on to do. Her function is to transport the sick, from the fleet, from an advanced base, or from an expeditionary force to the base hospitals at home. She may be required to remain with the fleet to supplement the facilities of the fleet hospital ship, or be attached to a home base to provide additional hospital beds. Contrast these duties with the mission of the fleet hospital ship, which is to provide complete mobile hospital facilities for the fleet, and you will better understand the differences in characteristics and equipment of the two types of ships.

Selection of the ship.—If possible, one should choose a vessel which is adapted to the part of the world where she will probably be employed. Thus, a vessel designed for tropical cruises would not be ideal for duty as a hospital ship in the Aleutian area in winter; and one which was designed for the transatlantic run might be too large to enter the harbors of the Pacific Islands. The size should bear some relation to the duty she is to perform. If she is to serve a fleet or an expeditionary force which is operating near a home base, two or more smaller vessels may serve better for this work; while if she is to operate in distant waters, a vessel of 10,000 tons or larger should be chosen. But, too often, the one who has to select the ship does not have complete information about her projected use, and the choice of ships may be very restricted. An oil-burning ship has many advantages over a coal burner for hospital purposes, but one must always consider the availability of oil or coal in the area where she is to operate. On one shore of the Pacific, for instance, oil is cheap and abundant while, on the other, coal is cheaper and more easily available than oil.

Speed is an important matter but it is not likely to be the deciding factor in choosing one ship or another. The greater the distances over which voyages are to be made, the more important is speed. Freedom from vibration at the higher speeds must be considered since constant shaking adds greatly to the discomfort of the sick. A passenger ship is infinitely more desirable than a cargo carrier. The latter, with her large holds, could perhaps carry more patients for the same tonnage, but the lack of heating, ventilation, toilet, and lighting facilities would give rise to many serious problems in the care of the patients. And the matter of cargoes previously carried is not to be ignored. We may agree with Thomas Moore that you may break, you may shatter the vase, if you will, but the scent of the roses will hang around it still; however, few of us appreciate the tenacity with which the aroma of copra, guano, hides, horses, and other fragrant commodities can cling round a ship. Flies, ants, roaches, and other vermin, not forgetting

the cimices, should be sought and the degree of infestation estimated. Adequate measures should be taken to free the ship from such pests before placing her in commission as a hospital ship, otherwise her usefulness may be seriously impaired.

Careful attention should be given to the auxiliary machinery and, if possible, a ship should be chosen that has plenty of reserve power in excess of that required for propulsion. Heat, light, distilled water, cold-storage plant, laundry, and hot-water circulating system will all have greater loads to carry while the ship is functioning as a hospital than during her passenger-carrying days. A passenger vessel is likely to be much better equipped with these facilities than is a cargo ship. Twin-screws are reputed to cause less vibration than a single propeller, while turbines produce less noise and vibration than reciprocating engines. Fuel capacity should be sufficient to give a steaming radius of at least 8,000 miles.

Steadiness in a seaway is a most important attribute in a hospital ship, and careful inquiry should be made to determine the reputation of the vessel in this respect. If she is unsatisfactory because of excessive or abrupt motion in rough weather, an expert should be employed to determine the cause, whether or not it can be corrected, and at what cost. Changes in ballast, bilge keels, and other devices will often be sufficient to correct this defect.

Since mines and torpedoes are the principal war-time danger to a hospital ship, one that is subdivided by many strong water-tight bulkheads offers much greater security than one which has large undivided spaces below the water line. In the World War, several of the hospital ships that were sunk by torpedoes or mines had very little or no loss of life because their construction was such that they sank slowly. If the ship is not satisfactory in this respect she should be made so before being used as a hospital ship.

After the choice of the ship is made, the next consideration will be alterations that are necessary. Before making decisions in this matter, we must try to get some idea of the service that she is to perform. If she is to make only short runs, up to 3 or 4 days, very much less space will be needed for laundry, fresh-water storage, operating room, commissary and medical store rooms, X-ray, dental clinic, physiotherapeutic equipment, and many other items; and so room will be available for a large number of additional beds. It is a generally-accepted rule that the farther away from the home base she operates the more complete her hospital equipment and facilities must be. Thus it follows that the longer the run the smaller is the patient capacity, and the larger the number of ships required to carry a given number of patients. But it is seldom possible to predict with accuracy just what duties the hospital ship will be called upon to perform, and so compromises will

have to be made that will allow her to play various roles with reasonable success.

One of the first steps to be taken is to have some competent person inspect the bulkheads and partitions to determine which ones are structurally necessary and which ones represent false work that can be removed. Only a few cabins should be retained, aside from those necessary for the personnel attached to the ship. By removing the partitions and making several cabins into one ward for 10 or more patients much space can be saved, and one nurse can care for several times as many patients in one ward as she can if they are separated in individual rooms. A feature often overlooked is accessibility. A bed in a room with a narrow door which one must approach down a narrow corridor is accessible only to an ambulant patient and the number of such rooms should be reduced to the minimum. Every effort should be made to arrange it so that a wheeled stretcher can be brought alongside every bed.

Assignment of spaces.—The main deck is extensively used for ship's work, handling stores and lines, musters and drills, so it is likely to be noisy and active, and sick patients will be disturbed if placed there. But it is a suitable place for lounging rooms and convalescent wards for ambulant patients, the admitting office and ward, baggage room and other activities that have to do with the receiving and discharge of men and supplies. Below the main deck should be the operating suite, X-ray, dental and other clinics, treatment rooms, store rooms, and offices for the various departments. Here also may be located wards for convalescents and quarters for the ship's officers. In general, the spaces below the main deck are utilized for activities where those engaged are not present throughout the 24 hours, while those above that deck are reserved for the sick who cannot leave their beds to seek light and air in the open. Activities which give rise to wild heat, much noise, or disagreeable odors should be grouped well aft of the wards. This applies to the bakery, galleys, laundry, butcher shop, vegetable lockers, blacksmith shop, and incinerator. The forward part of the ship should be reserved for quarters for the ship's company and the innumerable things which have to do with the running and upkeep of the ship. With this arrangement, all wards containing bed-fast patients will be concentrated in the center of the ship, above the main deck.

This location of the wards will, in most cases, place them adjacent to open or glassed-in deck space, and it is important to arrange the corridors and doorways so that beds, stretchers, and wheel chairs may be moved out on deck with the least possible trouble. This means that doorways should be wide and sills low. Access to the fresh air and sunlight on deck will give great satisfaction and comfort to the patients and will aid greatly in their recovery. It is our

experience with patients invalided home from France, the Philippines, Guam, and Hawaii, that a large proportion, even of the most serious cases, improve wonderfully during the voyage home and there is little doubt that this rule will hold in the future. Sea air, sunlight and the mental effect of "heading for the barn" are powerful remedial agents and should be used to the utmost on our hospital ships. Even the ship travels faster when headed for the home port, believe it or not. Every available inch of deck space should be devoted to the use of the patients whenever the weather is suitable and one should plan to make access to the deck as easy as possible. It is essential, both for their own health and for the administration of the wards, that ambulant patients be kept out of the wards and on deck as much as possible during the day. This will be made simpler if several spaces are glassed in with types of glass used for this purpose which do not exclude ultraviolet rays.

On a hospital transport it will not be necessary to make such a rigid assignment of special wards for surgical, medical, or other patients. As a rule they will have already received initial diagnosis, operation and dressing before being evacuated from the fleet hospital ship or base hospital on shore to the hospital transport, and continuance of the nursing care will be the essential thing. Usually it will make little difference if medical and surgical cases are in the same ward. It is customary to provide a separate place for sick officers, and a few cabins may well be reserved for those of higher rank and for sick nurses. Somewhere well aft, and on one of the highest decks, a small space should be reserved for contagious diseases that may develop on board during the voyage. It is better not to accept contagious diseases for transportation if it can be avoided. Another group requiring special consideration is the venereal. In all the hospital ships I have seen they have been located down deep in the hold, between the laundry and the steering-engine room, or wherever there was the most noise and heat, and the least comfort. Many of our very best soldiers will be found in this group and I strongly believe that they should receive the same consideration as others when wards are assigned. The most modern facilities should be provided for their treatment.

Mental patients will also require a special ward with elaborate provisions for their care and safety. A great number of men who probably would cope successfully with the daily routine of civil life become mentally unbalanced in the process of adjustment to the irregularities and hardships of a military regime. Even those who are aware of this fact habitually underestimate the number of insane, so it is well to provide lock wards for at least 5 percent of the bed capacity of the ship. If not needed for that purpose they are available for general use. It is better to have too many than too few, for

it is a source of never-ending astonishment, the number of annoying and dangerous things that a hyperactive insane man can think of to do to himself, to others, and to the ship, in a single unguarded moment.

A few large wards can be administered more easily and with fewer doctors and nurses than can many small ones. Sixty-bed wards have proved to be very convenient administrative units. One doctor, one nurse and 8 to 12 orderlies or male nurses can care for 60 bed patients of the type that will probably be carried by a hospital transport. Most passenger liners have large saloons and dining rooms which can be converted into excellent wards. Smaller wards will also be arranged by removing cabin partitions. Wherever a ward or a room for a patient is placed, one should make certain that patients can easily be brought alongside each bed in a wheeled or hand-borne stretcher. Unless absolutely necessary, do not place bunks in corners or against bulkheads, where they can be approached from only one side. This arrangement makes nursing care difficult and the patients are likely to be neglected. If it is deemed necessary to install such bunks, they should be reserved for convalescent patients who require little care, or who are able to leave their beds during the day. The space along the bulkheads can be used to better advantage for traffic and circulation of air. Passageways between the rows of bunks should be at least 3 feet wide, for if narrower than this it will be found extremely difficult to transfer the patients from stretchers to beds. One ward should be provided with 4-foot alleys for patients in plaster cases, double spicas, and elaborate suspension apparatus.

Several standard types of bunks will be found available on the market. Most of them have upright metal stanchions which support metal bunks on each side. For the convalescent wards those with either two or three tiers of bunks, such as are commonly used on transports, are suitable, but for those patients requiring nursing care, who must remain in bed day after day, something more comfortable is required. A reference to the photographs of the wards of the *Relief* will give a clear idea of her equipment, which is very satisfactory. The bunk frame should be 36 x 78 inches with the mattress large enough to fit snugly within the frame and not leave several inches of empty space between it and the frame. Whether that space be at the head, the foot, or the side, the patient's whole body seems always to be trying to gravitate into the empty place. The bunks should be hinged so that they can be turned up out of the way when vacant. A few standard type hospital beds and a few fracture beds should be installed in one of the smaller wards, and these must be very firmly secured to the deck for there is a powerful lateral thrust at the end of a heavy roll that few shoreside people appreciate. Before the end of the first trip, the doctor in charge will know exactly what cases he wants in these special beds, and he will be very grateful for them.

All bunks should be securely fixed in place. Do not allow anybody to induce you to have swinging bunks installed. The idea is so plausible that, as soon as it is suggested, everybody is willing to accept it at once as being just the thing. But experience says, "No, they do not work." If the movement of the ship were a simple, rhythmic, to-and-fro motion, they might do; but the real movement is a combination of an up-and-down, a lateral, a forward-and-back motion with an irregular corkscrew jerk for which no bunk, unless hung in gimbals, could compensate.

Each ward should have a diet kitchen with shelf room enough so that trays can be set up for at least one-third of the patients at one time. Refrigerator, stove, sink, and drain board must not be forgotten. In this and many other items, an experienced nurse can provide an infinite number of practical suggestions that no mere man would ever think of, so this source of information should never be neglected.

Generous provision must be made for toilet facilities and they must be near at hand. It has been a common fault in converted hospital ships, that the few toilets were at a long distance from the wards. This means more orderlies, more bed pans to be carried, more unpleasant odors in wards and passageways, also more discomfort for patients. There is no milestone on the road to recovery that is more eagerly anticipated by the patient than his first trip to the head, and it is a feeling worthy of encouragement. Many doctors, writing about their hospital ships, have warned against the error of insufficient toilets distant from the ward. For 60 beds there should be 4 toilet seats, 3 urinals, and 2 showers. Bath tubs should be replaced by fresh-water showers, for the tubs are seldom used; they require much work to keep them clean and they serve fewer men in a given time. The showers are better liked by the men; a shower uses only about one-tenth as much water as a tub bath, and 3 showers can be installed in the space required for a bath tub. All pipes and plumbing should be out in the open and easily accessible. Armies recruited in an emergency always contain a goodly number of men from remote places who are unfamiliar with the use of modern sanitary devices, and some who take pleasure in causing inconvenience to others. Between them, they will keep the ship-fitter's force busy unstopping toilets, wash basins, and urinals. So all toilet fittings should be chosen and installed with this in mind. A large stock of spare parts should be carried.

It can be regarded as certain that the ventilation existing in the ship will be found inadequate for ward purposes. In spaces continuously occupied, one should allow 300 to 500 cubic feet of space per man, and there must be a continuous flow of air, not only for respiration, but to remove odors. Natural openings, such as windows, ports, and skylights will seldom be sufficient and must often be closed, so

blowers and ducts will be required. It is not worth while to enter here into the mathematics of cubic feet per second, for the knowledge of air conditioning is progressing so rapidly that it is better to employ the best talent available in this specialty and follow his advice. But be sure that your expert is familiar with shipboard conditions. Supply ventilation should being the fresh air into the wards while the exhausts remove it to the topside from the heads, diet kitchens, and other spaces where odors may arise. This may seem too elementary to need mention, but more than one ship has been rigged so that the air flowed the other way.

Lighting should be indirect in the wards, or so arranged that the man as he lies in his bunk, does not gaze into a brilliant light, either overhead or at the side. Sufficient illumination must be provided so that the patient can read easily, for that will be his chief diversion. Night lights, similar to those used to illuminate the aisles of theaters, will be necessary to allow the work of the ward to be carried on at night without disturbing the sleep of the patients. Every ward and room will require alternating current and direct current outlets conveniently placed so that one can plug in the portable X-ray, electrocardiograph, ophthalmoscope, diathermy machine, floor polisher, vacuum cleaner, infrared or ultraviolet lamp, dental apparatus or any of the thousand and one gadgets that we depend upon in our daily work. Most passenger liners have an independent lighting system on an upper deck, to take over the load in case the engine room is flooded. This system should be employed and extended to take in the operating room, and perhaps certain of the offices, so that work can be continued during emergencies, if the usual source of light should fail. The radio has become a daily necessity and this fact should be recognized by installing either an antenna system to which individual radios can be attached, or a central receiving set with outlets to plug in individual ear phones. If some such action is not taken, the ship will be festooned with individual aerials hanging from every porthole and attached to every stanchion on the open deck.

Consideration should be given to the harmful effects of noise on the sick and the increased suffering caused by it. Worn gears on cranes, winches, and other deck machinery can set up a vibration throughout the ship that will make the sick men writhe in agony. This matter should be investigated and steps taken to correct it if necessary. Sound proofing should be employed in partitions and bulkheads when spaces for the sick are adjacent to noisy activities that cannot be subdued. Diet kitchens, lounging, and smoking rooms are noisy most of the time and partitions separating them from wards should be covered with material to deaden sound.

Elevators will probably be found already in the ship and their location will largely govern the assignment of wards and clinics. It is

essential that the main elevator be large enough to carry stretchers and allow the bearers to stand at the ends of the stretcher with the elevator doors closed. Since the elevator is the main avenue of communication between the wards above and the clinics and operating room below, it is necessary that there be wide corridors on all decks so that patients on stretchers can be conveniently handled. A careful study of the routes from one space to another should be made before finally deciding on the location of the various activities. It should never be necessary to use any ward or clinic as a passageway to some other compartment. Nothing is more likely to produce friction among the personnel.

The operating suite should be amidships, below the main deck, and so located that patients can conveniently be brought to it by elevator from the surgical wards and the admitting ward. The operating facilities need not be so elaborate as those of the fleet hospital ship, but must be adequate for any emergency of a surgical nature that is likely to occur. Sterilizing equipment should be generous in capacity for it is probable that a very large part of the patients carried on the ship will require surgical dressings. As the efficiency of the medical department of an armed force increases, the cases of preventable diseases will be fewer and the percentage of battle casualties among the patients will increase. So, the higher the ratio of wounded among the patients received on our ship, the more satisfaction we may feel in the sanitary work of our colleagues. Do not forget to provide toilet facilities and a shower bath for the operating-room personnel.

A large steam disinfector is an essential. It is probable that a large proportion of the patients received from a force engaged in active warfare on the beach will be filthy and lousy, as was the case during the Gallipoli campaign. Sterilization of clothing and bedding is likely to be a continuous process during the homeward trip, and so adequate facilities must be provided.

Dental work will consist largely of prosthetic appliances for injuries about the face, so a dentist skilled in such work should be selected. Generous provision for this work should be made, because the modern organization of units for the care of maxillo-facial injuries requires that continuous care be given such patients, from the front-line trenches until they reach the special hospitals at home. Our hospital ship will be an important link in that chain.

The same principle applies to provisions for the care of fractures. A very large part of the cases will probably be compound fractures, of all degrees of severity. Selection of staff and equipment should reflect consideration of this fact. Care of such patients will require more than the average number of nurses and orderlies, as well as doctors. The chief surgeon should select his staff carefully and be sure that there are plenty of the special types of apparatus that he prefers.

Much thought must be given to the matter of receiving and discharging patients. It is likely that several hundred disabled men will be put aboard and disembarked each trip. They may be brought to the gangway in boats; or a ship may come alongside with them. Shipwrecked men may be swimming or clinging to wreckage. Small boats may bring them in a rough sea. All of these require different methods and different apparatus. Special davits should be rigged for hoisting in patients. A large number of Stockes stretchers, or similar devices, should be provided and the crew constantly trained in methods of embarking and disembarking large groups of patients in stretchers.

What shall be the source of personnel for our hospital transport? Most of those of the past have been under command of a medical officer, with a sailing master to run the ship. Hospital transports will be notified to the enemy as complying with the requirements of The Hague Conference of 1907, concerning the immunities of hospital ships. It has always been accepted as good practice not to have combatant officers or men on such ships, even though there is nothing in the convention that prohibits them. The Red Cross Society has frequently been called upon to provide the doctors, nurses, and other professional personnel of such vessels and these persons have always been accepted as being noncombatants. Reserve naval officers have sometimes been employed to run the ships, but it is not likely that the enemy would discriminate between regulars and reserves, so far as their combatant status is concerned. Most nations have played safe by removing all combatant officers and men from duty on their hospital transports, so that there might be no question of their neutrality.

Suggestions for supplies and equipment can always be obtained by addressing the Red Cross Society, the army or the navy medical authorities of any country. It is very important that, after the staff is selected, the members study the lists of supplies to make sure that the articles they are accustomed to work with are provided.

IV. Organization and Administration

No matter how intelligently designed and structurally perfect the hospital ship may be, defective principles of organization may nullify its good features; for no machine can run smoothly or efficiently if its gears do not mesh. So far as the internal affairs of the medical department are concerned, there should be little difficulty, because hospital administration is now so completely standardized, in the United States and Canada at least, that doctors, nurses, dietitians, orderlies, and others, assembled from widely scattered hospitals, will find few details that differ from their accustomed routine. It is in

the relations between the medical department and the ship's officers and crew that friction is most likely to develop.

It is commonly observed among us that the naval point of view and the medical point of view move along widely divergent lines, and both are sufficiently inflexible that it is found to be very difficult to bend them to a focus on the common objective. The medical officer thinks first of the patient and his welfare, while the line officer thinks first of the ship, and of the organization that enables it to carry out its mission with safety and certainty. Each is likely to react with impatience to any interference in his field, so a kindly sense of humor in one or both is devoutly to be wished. The harmonizing of the two points of view, without too much dominance by either, is the prime essential of hospital-ship administration. It is the rock upon which have foundered the success and good will of several vessels that started out under most favorable auspices. To avoid such failure, there must be agreement on all details of command and authority before patients are received on board.

Fleet hospital ship

Fleet hospital ships, being direct agencies of the governments which they serve, will usually be organized in accordance with the regulations of their respective navies. Their personnel, composed in large part of officers and men accustomed to work under those regulations, will experience only slight changes from their peace-time activities, and so there should be relatively little friction.

In the administration of the *Relief*, a detailed scheme has been worked out which is very satisfactory for a fleet hospital ship of the United States Navy, though probably not appropriate for those of other navies. A list of the chapter headings of the ship's regulations of the *Relief* will suffice to indicate some of the problems that will arise, and on which early decision will be required. They are:

Organization—policy—personnel.
Berthing and stowage.
Messing.
Deck spaces and assemblies.
Divisional duties and details.
Ship handling—ship's routine.
The medical department.
Emergency drills.
Field hospital and mobile emergency unit.
Leave and liberty—disciplinary procedures.
Communications.
General regulations.

Hospital transport

Organization and administration of a hospital transport is likely to be quite a different proposition. Since these vessels will probably be required to make long voyages without protection of a convoy, it is important that no slightest act or condition should be permitted that may in any way jeopardize their immunity under the tenth convention of the Second Peace Conference, at the Hague, 1907. Therefore they should not be officered or manned by combatant personnel. While nothing in the convention expressly forbids combatant persons in a duty status on the hospital ship, belligerent nations in recent wars have gone to considerable trouble to make it known to the world that all the officers and men on their hospital ships were noncombatants. It appears to be the universally accepted belief that the presence of combatants would cause them to forfeit the immunities granted to hospital ships.

For this reason, hospital transports will probably be run by officers and men of the merchant marine. The medical and nursing staff may be army or navy personnel or they may be assembled from civil life. At present there are, in many countries, organized units of doctors and nurses, trained to work together and ready to respond at once, if needed for war-time service on hospital ships or on shore. This should greatly simplify the task of organizing the group for duty on such vessels. The Red Cross Society has been very active in aiding the work of hospital ships, and many vessels in past wars have been staffed and equipped by this admirable organization. The Hague Convention of 1907 provides rules for hospital ships belonging to philanthropic societies, as well as for government vessels.

It has usually been found advisable, when a merchant ship is taken over for hospital duties, to retain her officers and men. When the medical personnel report on board, the question immediately arises, which is the tail and which is the dog; who has authority to give orders to whom? This must be definitely settled, and a clear understanding reached at the outset, or else the resulting friction will be reflected in the quality of work of the ship. A review of the historical chapters will show that most hospital ships have been under command of the medical officer, while the captain was held responsible for the navigation and the safety of the ship. In other words, the doctor decided when and where to go, and the rest was up to the captain. Most of the friction and difficulties of the past have arisen between these two. Seagoing men resent being placed under a landsman, and the doctor, with his unaccustomed authority, can easily be tricked into an embarrassing and humiliating position by hostile ship's officers. One of the principal arguments in favor of placing the medical officer in command is that this method is generally accepted as best comply-

ing with the spirit of The Hague convention of 1907, and insuring the neutrality of the hospital ship.

Other matters that may be fruitful causes of disagreement are berthing of the ship's crew and the hospital attendants, stowage of ship's gear and personal effects, responsibility for cleaning various compartments, fuel and fresh water supply, use of ship's boats for transportation of patients and crew, assignment of spaces for ship's work and for recreation of patients, fire and abandon-ship drills, liberty for crew and patients, disciplinary procedures, upkeep of plumbing and other fixtures, handling of communications, uniform, pay, authority of the officer of the deck, and management of visitors. Many of these questions would find the landsman entirely unprepared to decide them. The essential thing is that the duties and responsibilities of each department of the ship should be clearly decided and put in writing before the vessel starts to function as a hospital ship. In emergencies, when everybody and everything is put aboard at once and the ship shoves off immediately, such an arrangement in advance is not possible, but one should insist on it whenever it is practicable.

Examples of the disadvantages of uncertain or divided responsibility are found in several hospital ships in the past. The *Victor Emanuel* had a naval officer, Captain Parkyn, in command, with Surgeon-Major Dr. Bleckly of the Army in medical charge, while the War Office authorities contributed a military commandant and an adjutant. The London Lancet, in an editorial (1873, 11: 824) comments satirically on this arrangement, "Whom is the major to command and what will be the official or clerical duties of the adjutant? We presume that the former is to have morning parades of the Army Hospital Corps, and that the adjutant has strict instructions to see that there is no waste in drug department. In fact, we can hardly imagine two fish so very much out of water." The numerous authorities represented here would afford ample opportunity for friction that would interfere with the administraton of the vessel and the care of the sick.

The *Bay State* was fitted out under the direction of 25 different committees, while another committee decided on policies and directed the movements of the ship. Dr. Burrell was surgeon-superintendent, with orders placing the vessel entirely in his charge. The safety of the ship, from the navigation standpoint, was in the hands of the master. The point to which the vessel should go, and the immediate control of the ship whenever it involved the welfare of the patients, in these, the master was placed under the surgeon-superintendent. It is recorded that many difficulties arose from this divided responsibility. The steward's department and commissary were under the master, while the cleanliness of the ship "was suggestively controlled by the Medical Department, except in parts of the ship directly controlled by

them." Here are fertile sources of constant bickering and, as one might anticipate, disagreements were frequent. It is to be regretted that we do not have more detailed information concerning the actual working of this strange and complicated organization, which must have been highly charged with political cross currents. The brief duration of the war alone would permit such an enterprise to end harmoniously, unless the heads of the committees, the surgeon-superintendent, and the master were supermen of tact and diplomacy.

Nishi relates that, in Japanese hospital ships, the chief medical officer takes charge of medical affairs and sanitation of the ship, and has the right to direct and command the captain as to the movements of the ship. The medical personnel of these ships have been supplied by the Red Cross Society.

Volunteer personnel, serving without pay, have been employed on some hospital ships, but this is not to be recommended. Extensive experience in disaster-relief work has taught the writer that the fine enthusiasm with which people throw themselves into such well-advertised humanitarian enterprises lasts for 10 days or less. As soon as the work slacks a little, and the volunteer workers have time to look about them, and to see others doing less work or receiving more compensation than themselves, the mantle of self-sacrifice wears thin and human nature begins to show through. Therefore, free service, or service for less than the standard wage, should be regarded as a very temporary thing. It is better to inform those who desire to donate their services that they will be paid the same as other workers, but may return the money to the organization if they so desire. Such organizations as the Volunteer Aid Detachment and Women's Auxiliary Army Corps in England, and the American Red Cross in America have proved invaluable for their work in recruiting and organizing people for such enterprises as hospitals and hospital ships.

One who has been given the task of organizing the medical department of a hospital transport, or a hospital ship under the control of a philanthropic society, without previous experience in such work, will do well to follow standard hospital procedures with the least possible adjustment for conditions on board ship. Such a book as Dr. MacEachern's, on hospital organization and management, will prove a very useful guide, and should be followed as closely as possible. Practically all the details can be safely left to the chief nurse and the doctors in charge of the wards, and they will work better if not interfered with by the senior, whose first few hours would be more profitably spent if he immediately went into a huddle with the captain of the ship. Here are some of the things which they should discuss.

Each man should be assigned a bunk, mattress, and a locker for his clothing. Bags, suit cases, and other containers are not to be kept in sleeping quarters, but in a storeroom provided for the purpose, and to

which they can have access at stated hours. Unless the steward's department of the ship is prepared to carry the whole burden of preparing and serving food, 1 man in each 20 should be detailed for this purpose. Peeling and preparing vegetables, washing dishes, cleaning the mess room, and other chores will keep them busy. Special arrangements will be necessary for preparing and serving diets for the sick, and the hours at which the various groups will have their meals must be arranged so that they will not conflict.

Night and day watches, and hours for liberty for all departments must be arranged, and it will be found that they all are interdependent. A cleaning bill should be worked out which will show in detail just who is responsible for cleaning every compartment of the ship, otherwise there will be continual friction and complaints. Who is to notify whom, when there is a leaky spigot, a stopped toilet, a burned-out sterilizer, or a broken chair to be fixed? Who has charge of the incinerator and the disinfector? Definite deck spaces are to be assigned to ship's company, hospital attendants, patients, nurses, and doctors, and notices posted so that there may be no trespass. Running-boat schedules, telephone watches, cleaning and inspection routines require careful consideration.

Preparation must be made to meet emergencies such as fire, collision, and shipwreck. Drills should be held frequently, until each person knows just what is his station and duty in any case. The matter of getting patients in and out of the boats, and bringing them aboard from boat or from dock requires constant practice. Abandon-ship drill should be carefully planned, with a definite place assigned for each patient, as well as for those attached to the ship. A lifeboat which is rated as carrying 30 persons will accommodate only about 7 or 8 stretcher patients. Each boat should be tested with the stretchers actually in place to determine its capacity in terms of stretcher patients, together with the necessary boat's crew and attendants for the sick. Each time the ship puts to sea, the abandon-ship drills should be repeated until each knows his station and duties.

This discussion gives some idea of the countless details that will occupy much of the time of the senior doctor during the first few weeks of his duty on the hospital transport. It is to be hoped that he and the captain of the ship will be able to establish a friendly and considerate understanding, so that all of these points may be arranged in an amicable manner.

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THE MAKING OF A BLUEJACKET

By Capt. Griffith E. Thomas, Medical Corps, United States Navy, and Lieut. Charles M. Parker, Medical Corps, United States Navy

How many stop to consider the factors concerned in transforming the average man into a bluejacket, what he must be made of, and what he must do? That the picture may be made clearer let us dissect the entire process and show how it is done.

Statistics quoted in this article are based on recruiting statistics compiled by the Recruiting Division of the Bureau of Navigation and the Recruiter's School at the United States Naval Training Station, San Diego, Calif. Although not accurate to the fraction, they are close enough to make clear our purpose.

About one-third of the men entering a recruiting station are "sight-seeing" and have no desire to enter the naval service. Out of 100 men who visit the recruiting office we shall take just 64 for this paper.

Of 64 men applying to a recruiting station for enlistment, 32 will be rejected for physical defects, distributed as follows:

Eyes	Face	Spine	Chest
Ears	Mouth	Lungs	Heart
Nose	Throat	Pharynx	Blood Vessels
Height	Weight	Pelvis	Abdomen
Skin	Teeth	Genitals	Nervous System
Head	Neck	Mind	Extremities

Of the 32 who qualify physically, 13 will fail to meet the educational requirements, and 6 others will be rejected for a record of the following:

Dishonesty.	Record of Court Conviction.
Vagrancy.	Unsatisfactory Environmental Factors.
Intemperance.	Family History of:
Criminal.	(*a*) Insanity.
Bad Character.	(*b*) Incurable Disease.

The remaining 13 men will be accepted and sent to a naval training station, where again they will be examined and the probability is that one will be rejected for defects either overlooked at the recruiting station or which developed while en route to the training station. Twelve will be vaccinated and placed in quarantine for the next 3 weeks.

After they have received their clothing allowance their training begins. They are observed carefully for communicable diseases, scabies, venereal disease, ringworm, trichophytosis, and other diseases. They are re-vaccinated until a primary reaction takes place or the Medical Department is satisfied regarding their immunity to

smallpox. They receive typhoid prophylaxis and are treated for any ailments they may have acquired. They are instructed in care of the feet and, as their training progresses, in other hygienic measures.

Meanwhile the Training Department has begun instructions according to the following schedule: Drill field; rolling clothing and bag inspection; lectures on what to do and what not to do to be a bluejacket; mess cooking; scrubbing clothing and policing up; study periods; watches; recreation periods spent mostly in well-equipped libraries.

The station chaplains assist during this period, as shown by the following schedule: Holy service, Catholic and Protestant, each Sunday; lectures on morals and marriage; advice to the men on Government insurance; places to go and places not to go, while on liberty; sponsor a happy hour every Tuesday evening for singing and an amateur show; allot periods for personal interviews to help men solve their problems.

Our 12 men, at the end of 3 weeks, are transferred from quarantine to another unit and start more vigorous training. Having been told about the evils and many vices confronting them and informed by a medical officer of the loss of health as well as time and money by venereal disease, they are allowed liberty on week-ends.

By this time they have a general idea of what to expect and what is expected of them. The Medical Department continues to observe them and their surroundings as it did during the quarantine period and cares for injuries and ills as may be required. The Red Cross stands ready to be of assistance, the Army and Navy Y. M. C. A. in the city exerts its every effort to help and, should it be necessary, the Navy Relief Society stands ready to lend a helping hand.

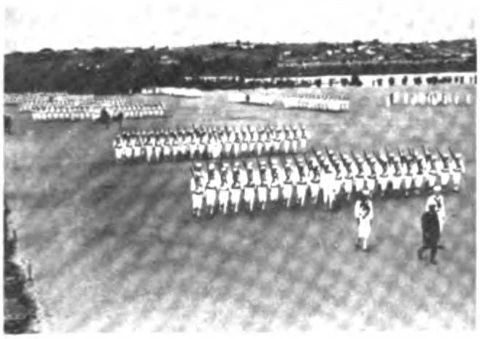
The Training Department works at double pace to make all possible preparations for the sea cruise, near at hand. The schedule incorporates: Seamanship, boat instruction; ordnance instruction; landing force instruction; mess duties; guard duties; general and special details.

During the last 2 months of training the selection officer looks over the men and gives examinations, so that the outstanding men may be sent to a trade school for special training, then they complete the 3 months' training period. About this time the probability is that one will be discharged from the Navy, due to inaptitude, bad conduct, or as an undesirable.

One of the men selected for special training, will not care to take the examination. Two of the men taking the examinations will qualify for the trade school and when completing the required course will be sent to sea. The others will be given 10 days' leave and upon their return, sent to sea.

RECRUITS.

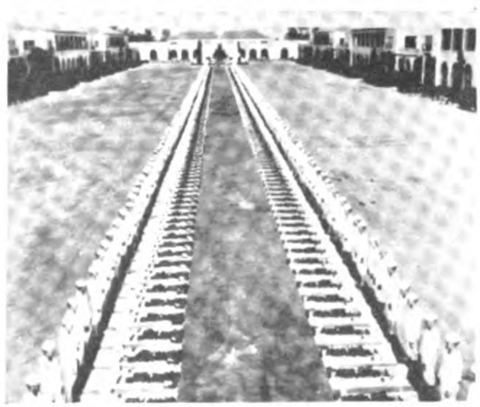
ENTRANCE.



DRILLS.

ATTENTION.

INSPECTION PERSONNEL.



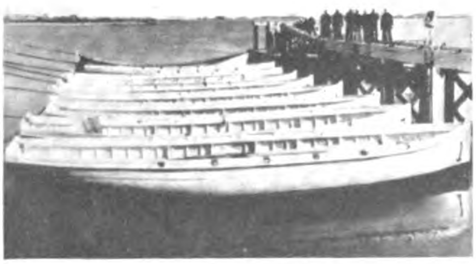
INSPECTION, BAG, IN WHITE.

Mess Hall.

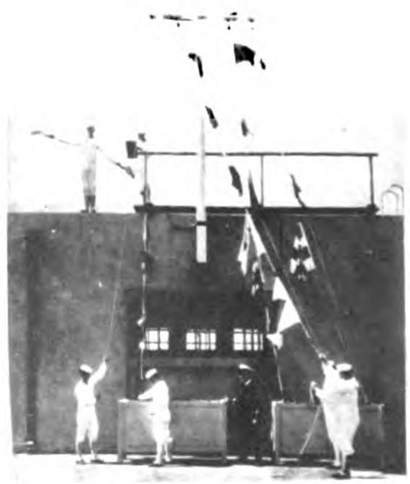
First Aid Instruction.

Class Room.

Library.



Boat Instruction.



Signal Instruction.

234—2

Each year 100 appointments to the United States Naval Academy are allotted to the enlisted personnel of the Navy, and each man knows he may take examinations for entrance, if he qualifies. The qualifications for entrance are as follows: He must have not less than 2 years high-school education, 9 months at sea, and be under 20 years of age on April 1 of the entering year. A recent report shows that of the 78 enlisted men who in April 1937 took the entrance examinations at the Naval Academy Preparatory School, United States Naval Training Station, Norfolk, Va., 66 attained passing marks in all subjects.

From among those recommended, candidates who could not complete the required 9 months of sea service in time to be assigned to the Naval Academy Preparatory School, 15 were successful in passing the entrance examinations while at sea.

This total of 81 successful candidates is the greatest number of enlisted men qualifying by examination for entrance to the Naval Academy since 1931.

Much lies ahead of this man we call a bluejacket. As 2 men go to trade schools and the other 9 climb the gangway, we bid them good luck, turn to start a new group, but for a moment we pause to think of the 53 men who started, but failed.

COMPRESSED-AIR ILLNESS[1]

By Lieut. CHARLES W. SHILLING, Medical Corps, United States Navy

III. SYMPTOMS OF COMPRESSED-AIR ILLNESS

Since the presence of free gas in the blood or tissue fluids is the cause of the illness, it is evident that the variety and severity of the symptoms will depend upon: (1) The location of the gas set free and, (2) the volume of this free gas. Thus, unconsciousness, collapse, and early death may result from emboli in the pulmonary or coronary arteries, or in the vessels supplying the vital centers of the brain. Pain may result from bubble formation in any unyielding tissue such as ligaments, fascia, periosteum, muscle spindles, or nerve sheaths. Air embolism either of the vessels or white matter of the spinal cord may cause paraplegia; while involvement of the cerebral vessels or tissues may lead to monoplegia, hemiplegia, aphasia, or sensory paralytic symptoms. Symptoms rarely develop from bubbles in the liver, spleen, kidneys, adipose tissue or veins. These "silent" areas far outnumber the "painful" areas, which in turn outnumber the "vital" areas; so except in cases of massive bubbling, the chances of serious involvement are slight.

Time of onset.—Symptoms have been known to occur during decompression, however, they are most commonly observed during the first few minutes following the completion of decompression,

[1] Continued from January 1938 issue.

although the onset may be delayed several hours. The old adage, "You don't pay until you leave," aptly expresses the usual sequence. Erdman (1913) in an analysis of 3,692 cases occurring at the East River tunnels found that 50 percent occurred within 30 minutes and 95 percent within 3 hours, but that 1 percent were delayed over 6 hours and 4 cases were said to have occurred between 15 and 23 hours after decompression. A previously mentioned report by the same author on 1.419 cases places the onset of symptoms within the first 30 minutes in 43 percent of the cases, and between 30 to 60 minutes in 32 percent of the cases. that is 75 percent in the first hour.

Classification of symptoms.—In the studies of Heller, Mager, and von Schrotter (1897), Hill and Macleod (1903), Keays (1909), and Bassoe (1911), the symptoms were classified according to the type and frequency with which they occurred. In this study it is felt that it is more advisable to consider symptomotology as it relates to the various recognized body systems, that is: (1) Cerebrospinal system (2) cardiovascular system (3) pulmonary system, (4) visceral and urogenital system, (5) structural system (to include oseous, connective, muscular and fatty tissues), and (6) dermal system.

1. *Cerebrospinal system.*—Many of the early authors thought that this was the only system involved in the illness. Audibert (1906) says, "Diver's paraplegia is a single form and the variability of details should not be permitted to obscure the regularity of the main clinical stages." However, in the same year, Boinet (1906) reports cases of paraplegia, monoplegia, hemiplegia with aphasia, quadroplegia, and facial paralysis. Previously, Boinet and Audibert (1905), jointly presented many cases of which the following are typical: paresia of the left upper limb with itching and a sense of pressure; transitory paraplegia with hyperesthesia, anesthesia, general sensory involvement, or with spasmotic contractions; permanent paraplegia with retention of urine and obstipation; hemiplegia, transient or permanent, with facial paralysis, or with aphasia and temporary insanity; and quadriplegia. Cazamian (1912) gives a most complete and interesting history of a case of this illness characterized by spasmotic paraplegia. Bassoe (1913) presented four cases: one showing permanent sensory loss in the left ring and little finger; another, permanent analgesic area on forearm; another, persistant pain in legs and precipitate micturation; and another, permanent increased reflexes and sensory disturbances of lower legs. Rise in temperature is considered by some as an important symptom associated with cerebrospinal system involvement. Clark (1870–71) presented 35 cases (predominately paralysis) which occurred during construction of the St. Louis bridge. Further presentation of cases is unnecessary for it is evident from the foregoing that symptoms produced by compressed-air illness can simulate those due to almost any other injury of the cerebrospinal system. Thus

we may expect anything from numbness and tingling of an extremity to complete unconsciousness and collapse.

Envolvement of the special senses may also occur and many cases of labyrinthine and apoplectiform deafness have been recorded. In fact Meniere's symptom complex is relatively common and vertigo, either alone or associated with other symptoms is frequently noted. Involvement of the eye is relatively uncommon but diplopia, nystagmus, and transient blindness have been reported. Also Callan (1907) reported a case of double chocked disks, Genet (1933) one of optic atrophy, and Pflimlin (1934) one of occular involvement with cataract formation, all due to compressed-air illness.

If these cases terminate fatally, death usually occurs weeks or months after the exposure and is the result of complications such as pneumonia, cystitis, pyonephritis, bedsores, exhaustion, etc.

2. *Cardiovascular system.*—It is difficult to classify the symptoms due to involvement of this system for the changes in any part of the body may be due to blocking of the arteries in that locality. For example, the blocking by air emboli of any endartery in the cerebrospinal system might lead to infarction in that area and a train of symptoms similar to those mentioned under involvement of the cerebrospinal system. There is ample evidence to show that embolism of coronary or pulmonary vessels may precipitate cardiac failure, collapse and death; or massive embolism may cause fatal cardiac dilatation. The bluish mottling of the skin in severe cases is undoubtedly due to embolism of superficial vessels with consequent stasis. Viguier and Jean (1918) report a case of embolism of the gluteal artery necessitating surgical removal of the resultant necrotic area, but usually the emboli involve the smaller arteries. Rupture of the overdistended small arteries may occur and the resultant eccymosis cause tissue damage. Lymphatic damage may explain the small superficial areas of localized swelling or edema sometimes seen.

3. *Pulmonary system.*—Dyspnoea resembling an asthmatic attack and called "chokes" by the men, occurred in 1.5 percent of the 3,692 cases reported by Erdman (1913) and is undoubtedly due to multiple small gas emboli in the pulmonary vessels with resultant edema. This is always considered a grave symptom for it is evidence of massive embolism.

4. *Visceral and urogenital systems.*—The internal organs such as the liver, spleen, and kidneys do not usually give any signs or symptoms although involvement may be found at autopsy. Nausea, vomiting, and epigastric pain are often encountered and are probably due to embolism of the omental, mesenteric or gastric arteries. These are usually considered to be grave symptoms for they are also suggestive of extensive embolism. "Girdle pain" is probably associated

with spinal cord involvement as is constipation, retention of urine, and impotency.

5. *Structural system (to include osceous, connective, muscular, and fatty tissues).*—Involvement of these tissues is almost invariably associated with pain; and pain is by far the most common symptom in this illness—occurring in from 85 to 90 percent of all of the cases, either alone or associated with other symptoms. In about 70 percent of the cases, the pain is in the lower extremities, usually in the region of the knees, and in the majority of the remaining cases in the elbows or shoulders, with occasional cases involving the trunk. Swelling of the muscles or joints is sometimes noted. The myalgias, arthralgias and ostalgias are described as tearing, boring, gnawing, or lancing in character and when severe, only recompression seems to give relief. Mild attacks of pain are experienced at one time or another, by almost everyone who "takes pressure," but they usually clear up without treatment and leave no residuals.

However, Bornstein and Plate (1911–12) report that chronic arthritis can result from repeated attacks of compressed-air illness, through bone necrosis from arterial emboli and nutritional disturbances in the surrounding bony parts. Bassoe (1913) reports several cases of arthritis deformans resulting from compressed-air illness; Twynam (1888) reports a case of bone necrosis; Plate (1912) reports cases with joint symptoms, muscular atrophy and X-ray evidence of bone pathology; and Christ and Basel (1934) report bony changes due to repeated air embolism, leading to joint pathology.

6. *Dermal system.*—One of the most common symptoms of compressed-air illness is pruritis or formication which is often the first and may be the only symptom noted. This is probably due to air bubbles in the subcutaneous tissues or in the sweat glands. Hemorrhagic areas are noted and a rash is frequently seen resembling that of scarlet fever. Lividity or marbling of the skin, as reported by Mellinghoff (1934), is associated with many of the serious cases and is probably due to air embolism of cutaneous vessels. Areas of swelling, subcutaneous emphysema, and crepitation occur in occasional cases.

Diagnosis.—In spite of the multiplicity of symptoms, a diagnosis of compressed-air illness can usually be made if the history shows exposure to air pressure, under conditions capable of producing the illness, during the preceding 12 hours. It must be constantly borne in mind, however, that other injury or illness may occur; thus, a careful differential diagnosis is always necessary. For example, the author knows of a case of acute appendicitis, one of fracture of the femur, and one of oxygen pneumonia which were erroneously treated by recompression, and of one man with paraplegia due to a fractured spine who was transported 38 miles in a touring car seeking recom-

pression, because he had been diving—into the water from the superstructure of his yacht! In most cases the men working under pressure carry cards advising anyone who finds them unconscious or acting queerly, to return them at once to the company doctor or the recompression chamber. In commercial work simulated accidents and hystero-traumatism must be kept in mind.

Pathology.—The pathology of compressed-air illness is almost as varied as the symptomatology, but the fatal cases logically fall into two groups: a rapidly fatal group, or those who die within a few hours after coming out of pressure; and a delayed fatal group, or those who develop cerebrospinal symptoms and die from secondary complications after several days, weeks, or months. Von Schrotter (1898) summarized 137 fatal cases occurring between 1854–97 and 70 cases with 18 properly reported autopsies in the rapidly fatal group, and 36 cases with 26 autopsies in the delayed death group.

In the 18 autopsies on the rapidly fatal group he found 11 which showed free gas in the circulatory system and in the other 7 congestion of the lungs, liver, etc., which in some resembled suffocation. Heiberg (1878), Gerard (1884), Nikiforoff (1893), and Lie (1904), all described autopsies on early death cases with findings similar to those above. Rudge (1907), Nordmann (1928), and Ghose (1930) have described autopsies on early death cases in which not only was there bubble formation in the circulatory system and in the tissues, and marked congestion of the visceral organs; but there was also micro- and macro-scopic hemorrhage throughout the tissue of the cerebrospinal system. Necrosis due to emboli blocking the circulation, and actual tearing and separation of the fibers due to local bubble formation have also been noted in the cerebrospinal system. Boycott and Damant (1908) in an exhaustive experimental study demonstrated that bubble formation was more frequent in the blood than in any other tissue or fluid, although bubbles are found in lesser quantity in all the body fluids. Since the greater the circulation the more rapid the elimination of excess gas, it follows that in bodies dead of compressed-air illness the bubbles would be found more numerous in the parts with sluggish circulation and less commonly in organs with an abundant blood supply. Thus, bubbles are seldom found in the tissues such as glands or muscles, but are usually found in the fat, the white matter of the cord and the myelin sheaths of the nerves—all tissues with a poor blood supply. Another factor in this connection is that fat dissolves more than 5 times as much nitrogen as water or blood at body temperature. As regards the segments of the cord, the bubbles appear to vary in number in inverse proportion to the blood supply, while necrosis is more or less directly proportional to bubble incidence. In résumé, the characteristic pathological findings in the early deaths are: Air embolism (bubbles) in

the various arteries and veins, more commonly in the smaller end arteries, but in cases a massive embolism filling larger vessels. Secondary to this embolism there may be infarction, necrosis, edema of the lungs, or dilation of the heart. Bubbles are also found in the various tissues of the body causing stretching and tearing (which in life resulted in pain or, if in the cerebrospinal system, altered sensory and motor function). Marked congestion of the various internal organs is also often found and frequently hemorrhagic areas are noted in the cerebrospinal system.

The delayed or chronic deaths occur as the result of secondary infection following paraplegia or other persistent paralysis. Exhaustion and septic infection from bed sores account for the three deaths reported by Sewall (1915). The spinal cords in these patients showed many areas of "softening and disorganization" in the lumbar and lower thoracic regions. Complete degeneration of the ascending fibers in the posterior columns was noted in one case and destruction of the descending tracts in the lateral area in another. Blick (1909) noted fatal urinary tract infection in several of his paraplegic cases. Bauer (1870) presents an autopsy showing spinal cord softening throughout the length of the lumbar segment in "the posterior columns, posterior cornua of the gray substance, and the lateral column of one side." Granjon (1880) reported a case with softening of the gray substance of the cord in the upper lumbar region, about 2 centimeters long, and with a spot of complete necrosis in the center. This man had paraplegia, retention of urine and bed sores and "steadily became worse," dying after 5 weeks. In a case reported by Chaubaud (1883), dying after 1 month of paraplegia and urinary retention, an area of softening, 2.5 centimeters long, was found in the grey matter of the cord at the lumbar level. Similar autopsy findings of chronic death cases were also reported by Sharples (1894), Schaeffer (1898), Zografidi (1907), and Noica and Paroulescu (1933). Of course no bubbles of gas or acute congestions are found in the autopsies of these delayed death cases, for the pathology is limited to softening, degeneration or infarction of the cerebrospinal system with occasional infarcts of other tissues, and evidences of secondary infection.

Extensive experimental work was performed by Curcio (1899) and Battaglia (1904), who not only found the usual cord pathology but demonstrated nerve cell changes due to the action of compressed air even in the absence of embolism.

Cases bibliography.—Many authors presented one or more cases of compressed-air illness with a very general discussion of the nature of the illness, which, although falling logically in this section, did not appear to add materially to the detailed discussion of symptoms. These comprise an additional or third bibliography which follows the primary and secondary bibliographies of this section.

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IV. Treatment of Compressed-Air Illness

The treatment for this illness is recompression, that is, a return of the patient to compressed air either by lowering him in the water again, returning him to the working chamber, or placing him in the medical lock or recompression chamber and raising the air pressure. The relief obtained by a return to compressed air was noted by the laborers as early as 1854, and yet 70 years later an author (1924) says of two cases showing paralysis, "Treatment was with potassium iodid, hexamethylenamin, massage, and tepid baths." One case improved after a month's treatment; the other showed no improvement. A great variety of treatment was suggested by Corning (1890) including morphine, catharsis, electrical stimulation, compression of the blood vessels of the lower extremities, dry cups to the spine, and the use of ergot. The benefit derived from the use of ergot was also enthusiastically reported by Knapp (1891—see sec. II). The use of antipyrine as a method of ameliorating the pain was suggested by Sene (1895–96). Many authors recommended massage, friction, and heat in one of the following forms: Wet compresses, baths, sand bags, and hot drinks. Various salves were recommended as well as numerous drugs for both external and internal use. Recompression was recommended by many of the early writers only for the most serious cases, and several wrote, "The treatment is mainly a question of prophylaxis."

The first recompression chamber or medical lock in the United States was installed at the New York North River tunnel works in 1894 and its success was reported as complete. From this time on, with but few exceptions, recompression was the treatment used wherever pressure work was conducted. An excellent summary of cases treated by recompression is made by Wright and Brady (1932—see introduction, p. 11) in which they show that of 3,067 cases treated by recompression 89.3 percent were completely relieved, 9.9 percent partially relieved, and only 0.5 percent showed no relief. Medical treatment of 211 cases gave no relief in 13.7 percent—a very definite demonstration of the superiority of recompression. Another report presents 47 cases of prostration (the most severe type of illness) treated by recompression with relief or cure in 38 cases.

The recorded opinion is unanimous that the treatment recompression should be started as soon after the onset of symptoms as possible, for it is felt that the benefits derived from recompression are largely dependent upon its early institution; although treatment has been known to be effective even when instituted many hours after the onset of symptoms. Kropveld (1907), who successfully treated 77 of his 98 cases by recompression, says that the greater the delay after the onset of symptoms the higher the pressure necessary to relieve them. And as pointed out by Langlois (1911—see sec. VI), a delay

in recompression may lead to permanent cord lesions due to long continued anemia caused by blockage of the circulation. Certain mild cases will of course recover without treatment, but as it is impossible to predict when these mild cases will suddenly become severe it is best to treat all definitely diagnosed cases by immediate recompression.

Although there is complete agreement on the advisability of immediate recompression there is great divergence of opinion on the management of recompression. The first point of difference concerns the rate of application and the amount or degree of pressure to be employed for the recompression. Some state that the pressure should be applied slowly, but the majority of opinion is in favor of rapid recompression. Concerning the degree of pressure, one observation is that the pressure be raised only until the symptoms are relieved, another that the pressure be raised to one atmosphere beyond the point of symptomatic relief. Ryan (1909) (1912) contends that the pressure must never exceed two-thirds that of the original working pressure, but the cases he cites in support of this plan did not respond to his treatment. Cazamian (1912—see sec. III) recommends rapid recompression to three or four atmospheres and if there is no amelioration of the symptoms the pressure may be raised to double that amount—nine atmospheres having been used for one case. The predominance of opinion, however, favors recompression to a pressure at least equal to that to which the worker was exposed. Keays, Bornstein, Dominquez, Stott, and many others, all of whom have been previously cited, recommend this recompression.

Sakai (1934), after extensive research, offers two alternatives: One that the pressure should be raised to the same height as that of the working chamber and held at least 45 minutes at that level; the other that it should be raised 10–15 pounds higher than the working pressure, thus hastening the reabsorption of the gas bubbles and allowing the time of treatment to be shortened. Normura (1929), in animal experiments, also found that response to treatment was better when the recompression was carried to a pressure "slightly higher" than that of the original exposure.

Opinion differs greatly as to the length of time the patient should be held at this maximum treatment pressure. Oliver (1934) recommends slow recompression to the original working pressure and then holding the pressure at this level for as long as 4 hours; but Cazamian (1912—see sec. II) says a wait of over 2 hours is useless and if paralysis does not clear in that time the pressure should be lowered. Bornstein (1912—see introduction) says that under no circumstances should the pressure be lowered at once but should be held at the maximum level at least 20–30 minutes and sometimes much longer; but Keays (1912—see introduction) says that after reaching the working pressure the treatment decompression should be started "soon."

Many of the authors do not mention any time element in this connection but the majority suggest waiting until the symptoms subside, or for at least 20–30 minutes.

The greatest difficulty in the treatment of the illness by air pressure is encountered in determining the type and length of the treatment decompression—that is, the return to atmospheric pressure from the treatment recompression. Among the authors already mentioned the following are some of the methods suggested for lowering the pressure: "2 minutes per pound," "2–3 minutes per pound," "about a minute per pound," 60 to 100 minutes per atmosphere—in nervous conditions much longer," "½ pound per minute," "quickly to 10–15 pounds and then slowly at the rate of 2 minutes per pound," "very slow decompression," and "long continued in ominous cases." The United States Navy official treatment tables (United States Navy Diving Manual) are of the continuous decompression type and recommend rapid reduction of pressure down to 60 pounds, 1 pound per minute from 60 to 45 pounds, 1 pound in 3 minutes from 45 to 30 pounds, 1 pound in 5 minutes from 30 to 15 pounds, 1 pound in 10 minutes from 15 to 0 pounds (gage pressure). However the proposed new treatment tables are of the "stage decompression" variety. French (1916) gives a good description of the United States Navy method of treatment, and Johnson and Bradlow (1925) present a case treated by the British Navy method. As pointed out by several authors it may be necessary to stop during the decompression because of the reappearance of symptoms and again raise the pressure. The author visited in the former Cunningham Sanitarium in Cleveland and saw patients who had spent months continuously at a pressure of 30 pounds (gage) with no ill effects, so it is evident that if symptoms do reappear during the return to atmospheric pressure, the pressure may again be raised slightly or held indefinitely.

The use of oxygen in conjunction with recompression to hasten reabsorption of the nitrogen was suggested 40 years ago in an article by Zuntz (1897—see sec. II); but because of the known toxicity of oxygen at high concentrations its use was not widely accepted. However, von Schrotter (1906) (1907) again suggested its use at low partial pressure to hasten decompression, and Boinet (1907) recommends its use in the treatment of "diver's disease." More recently Behnke and associates (1936) (1937), in extensive animal experiments, studied the use of oxygen in the treatment of compressed-air illness and highly recommended its use in conjunction with a special form of recompression outlined by them.

The use of mixtures of oxygen and helium in the treatment of compressed-air illness was suggested by Sayers, Yant, and Hildebrand (1925). Because of the physical nature of helium it is ideal for use in displacement of excess nitrogen and thus is equally as effective as pure

oxygen in addition to being nontoxic (the usual oxygen concentration of this mixture is approximately 20 percent that of atmospheric air).

Adjuncts to the treatment by recompression were suggested by Pelton (1907) as follows: Artificial respiration, exercise, massage with various concoctions, electric stimulation, ironing muscles with a hot iron, analgesics for pain, hyperdermics of strychnine, adrenalin, caffein, and general nursing care. He recommends breathing oxygen only at atmospheric pressure. Others have suggested: Hot baths, hot wet dressings, ergot injections, ether injections, camphorated oil rubs, intracardiac injection of adrenalin, etc. It is evident that much of this treatment is handed down from early times but even among more recent writers there seems to be quite general agreement that, in addition to and during treatment decompression, exercise is desirable, that hot applications and massage to the affected parts are of benefit, that stimulation by drugs may be indicated in some cases, that oxygen or helium-oxygen breathing is valuable, and that general nursing care is always to be carried out.

In summarizing the treatment of compressed-air illness we conclude: That recompression should be started at once and carried rapidly to at least the pressure of the original exposure, that this pressure should be maintained until symptoms disappear or for a minimum of 30 minutes or a maximum of 2 hours, that the treatment decompression should be at a rate of not less than an average of 3 minutes per pound reduction (the better type would be a stage decompression calculated for maximum saturation of the slowest tissue at the depth of original exposure), that oxygen or oxygen-helium mixtures should be breathed, that massage and exercise are indicated, and that stimulation may be needed along with other nursing care as becomes necessary for each case.

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V. PROGNOSIS OF COMPRESSED-AIR ILLNESS

The incidence of this illness is almost 100 percent, if the trivial as well as the severe cases are counted. In fact, in building a bridge over the Eider in 1885, at a pressure of 2.6 atmospheres above normal, there were 380 cases of illness in 140 men. In 1840 in the Strepy-Braquegnies mine (+2.7 atmospheres) all except one worker suffered the illness and in the pressure work for the Bayonne bridge over the Adour, 90 percent of the workers suffered. Silberstein in 1911 (all authors in this section are mentioned in the bibliographies of other sections) reported an annual morbidity of 200 percent among his workers. Keays in 1909 reported 3,692 cases among 10,000 men, that is 36.92 percent; however, on the basis of man-shifts or individual exposures (557,000) the percentage of illness was only 0.66 percent.

Mortality in this illness is remarkably low at the present time due to the almost miraculous results of recompression treatment, whereas

prior to its use the mortality rate was frequently very high. Blick in 1909 said that 60 out of 200 severe cases among pearl divers were dead before they reached a doctor and others died later. Jeminet in the St. Louis bridge work reported 119 cases of illness with 52 developing permanent paralysis and 14 dying, or a mortality of nearly 12 percent. Dominquez reported that among 550 men working on the foundations of a building there were many mild cases, 106 cases of serious paralysis and 14.9 percent deaths. In the construction of the Brooklyn bridges the mortality was nearly 3 percent. The value of recompression is well illustrated by the work on the Hudson River tunnel where the mortality dropped following the installation of the medical lock from 25 percent to 1 percent. In the extensive work on the New York East River tunnels over a period of 2 years the mortality rate was 2 percent on the basis of men employed but on the bais of working shifts was only 0.0035 percent. In England during the construction of the Blackwall tunnel there were 200 cases but no deaths.

It is of course evident that the prognosis is much graver in a case showing early collapse or unconsciousness than in one with only pain in a joint. Also cases with severe paralysis are quite likely to be difficult to cure and may end by having permanent paralytic changes (6 percent in one series). Even here, however, the prognosis is much better in cases of paraplegia due to compressed-air illness than in paraplegia due to other causes.

From the foregoing it is clear that if proper treatment is given in cases of compressed-air illness the prognosis for complete cure is favorable and the mortality rate is negligible.

VI. Prophylaxis of Compressed-Air Illness

In discussing the cause of compressed-air illness in section II, it was stated briefly that tissue nitrogen saturation was determined by the depth of pressure and the length of exposure to this pressure. In a closer analysis we find that in addition to these factors there is the very complex factor of body tissues and their physiology. This problem was taken up in great detail by Boycott, Damant and Haldane (1908), who considered such factors as blood volume, blood velocity, heart rate, volume of blood passing thru the lungs and volume of air breathed per minute under circumstances of rest or exercise, proportion of blood to the rest of the body, proportion of fat, and the relative solubility of nitrogen in the various tissues. They evolved, after much calculation, a logarithmic curve which demonstrated the progress of saturation with nitrogen for any part of the body. They concluded that for practical purposes they would divide the body into those tissues which attained 50 percent saturation (total saturation time for any tissue is difficult to determine because it approaches infinity as a limit) in 5, 10, 20, 40, and 75 minutes. From experimental observa-

tions it was found that, for practical purposes, after an exposure of 5 hours saturation was complete.

It is of course evident from further review of section II that the cause of compressed-air illness is the failure to properly eliminate the nitrogen which has been stored in the tissues. Thus prophylaxis depends upon the safe elimination of this nitrogen, and this process is called decompression. Whether or not the results of decompression are satisfactory will depend upon the following factors: (1) The extent to which the blood and tissues have become saturated—(2) the extent to which they have become desaturated during the stages of decompression, and (3) the degree to which the tissues will stand supersaturation. By supersaturation is meant the property of the tissues and tissue fluids to hold in solution excess amounts of nitrogen gas, absorbed under increased air pressure, after the external air pressure has been lowered. The phenomenon which makes this possible is probably the colloidal nature of the tissue fluids.

By extensive experimentation it has been shown that supersaturation to the extent of about 1.25 atmospheres above normal atmospheric pressure can be borne without the risk of nitrogen emboli formation—which is to say that a diver can safely return to the surface from a depth of approximately 41 feet sea water without the necessity of decompression. Therefore decompression should be sufficiently slow so that even the slowest tissues do not have, at any time, a supersaturation greater than 1.25 atmospheres excess pressure, but in order to reduce the amount of exposure the decompression must be as rapid as possible. Boycott, Damant, and Haldane (1908) state—

> A pressure of 1 to 1.25 atmospheres above normal corresponds to from 2 to 2.25 times the normal atmospheric pressure; but the volume (not the mass) of gas (measured at the existing pressure) which would be liberated if the whole excess of gas present in supersaturation were given off is the same whether the absolute pressure is reduced from two to one atmospheres, or from four to two, or from eight to four. Hence it seemed probable that, if it is safe to decompress suddenly from two atmospheres of absolute pressure to one, it would be equally safe to decompress from four atmospheres absolute to two, from six atmospheres absolute to three, etc. * * * The process of desaturation can therefore be hastened very greatly by rapidly reducing the absolute pressure to half, and so arranging the rest of the decompression that the saturation in no part of the body shall ever be allowed to correspond to more than about double the air pressure.

On the basis of these facts new "stage" decompression tables were calculated for various times and depths of exposure and appear as Tables I and II of Appendix IV of the above article. These tables are still in use by the United States and British Navies as well as in other diving activities. Haldane (1908) (1922) describes the method of calculating the tables and demonstrates the superiority of stage over continuous or uniform decompression.

It is evident that when the reduction of pressure has been completed there is still excess nitrogen held in supersaturation, which is given

off according to the same curve as that of saturation, provided no bubbles have formed. Thus, as pointed out by Stewart (1913), Perry (1923), and many others, a second exposure before all of the excess nitrogen has been eliminated is dangerous and will require a longer second decompression.

Although most cases of compressed-air illness are due to faulty or difficult decompression the examples of the illness given by Earl (1924), Baske (1929), and Beeching (1930), are considered sufficient for illustration.

A study of 46 cases of experimentally produced compressed-air illness was presented by Shilling, Hawkins, Polak, and Hansen (1935), in which the tissue saturation of the theoretical 5-, 10-, 20-, 40-, and 75-minute tissues was accurately determined and it was found that the saturation of the 5- and 10-minute tissues had no bearing on the production of the illness, and that the saturation of the 20-minute tissues might be allowed to reach a ratio of 2.8 to 1 before symptoms appeared, rather than the 2.25 to 1 ratio advocated by Boycott, Damant, and Haldane (1908). On the basis of these findings a new method of calculating decompression tables was suggested by Hawkins, Shilling, and Hansen (1935), which materially shortens the time of decompression for short and low pressure exposures. Numerous other modifications have been suggested: Morrison (1933) demonstrated the method of calculating decompression tables and suggested shortening the last stop; Kagiyama (1934) on the basis of a study of the nitrogen content of the urine following pressure exposure suggested shortening the tables; Shilling and Hawkins (1936), in an analysis of 2,143 "lung" escapes, found that it was possible to stay 37 minutes at 100 feet, 18 minutes at 150 feet, etc., and then safely come to the surface without any decompression. Hawkins and Shilling (1936) presented experimental results demonstrating the feasibility of surface decompression, that is, bringing the diver directly to the surface and then immediately giving him the decompression for his dive in a recompression chamber.

Dorello (1934) and Behnke, Thomson, and Shaw (1936) studied the rate of nitrogen elimination in men breathing commercially pure oxygen, calculated desaturation curves, and suggested changes in the decompression tables. Ham and Hill (1905), Zuntz (1909), Bornstein (1910), and Hill (1910), all suggest oxygen breathing in order to shorten decompression as well as prevent the development of compressed-air illness. The breathing of helium-oxygen mixtures to shorten decompression was suggested by Sayers, Yant, and Hildebrant (1925, see sec. IV), the Editor of "Umschau" (1925), Sayers and Yant (1926), and Yant (1927).

Official regulations have been drawn up by various countries as well as several of our states. German regulations are reported by

Heller (1898), Salessky and Libow (1901), and Leymann (1921); Russian by Zalieski and Liboff (1901); French by Wasserberg (1905 and Silverstern (1910); Dutch by Wintgens (1907); Swiss by the Swiss National Accident Insurance Department (1933); New Jersey and New York regulations by Erdman (1918); Detroit tunnel regulations by King (1910); and New York regulations by Japp (1913), and Levy (1917).

Other than these official regulations governing the conduct of pressure work there are many excellent general articles concerning the problem of prophylaxis. De Mericourt (1868) (1869) suggested the necessity of a very careful choice of divers on the basis of physical fitness, the regulation of the diet during diving operations, quick descent, not over 2 hours exposure at 30 meters, slow decompression, and the presence of a doctor on the premises of the diving operations. Langlois (1906) (1910) (1911) discusses the value of the varius types of decompression and suggests the use of oxygen inhalation and exercise as adjuncts to the stage method of decompression. Plesch (1910) recommends the use of stage decompression and stresses the physical examination strongly, saying that not only should they "reject cripples, weaklings, persons with infectious diseases, tuberculosis, alcoholism, lung, heart, nerve, kidney, and stomach ailments," but also special attention should be paid to circulatory efficiency, and that fat men, men with heart failure or vasomotor weakness, chlorosis, anemia, diseases of the central nervous system, nephritis, or those with ear disease should be barred from pressure work. Glibert (1912) (1914) discusses at length the value of the uniform method, the Holland method, and the stage method of decompression and decides in favor of the stage method. Stewart (1913) considers the following points important: adequate air supply, rapid descent, limiting time on the bottom, stage method of decompression, and careful physical selection of divers. "Hygiene of divers" is discussed in two articles by Moschini (1934). Cazamian (1927) discusses the French regulations and stresses the necessity for medical control and supervision, careful physical selection, and periodic reexamination, abstinence from the use of alcohol, and many other general and specific prophylactic measures.

Rigid physical selection and frequent reexamination is required of deep-sea divers in the United States Navy (1924) (1927). Not only are the men carefully selected according to the physical standards laid down by the Medical Department but "qualified divers shall be examined physically periodically and special examination shall be made in the case of all men prior to all deep diving operations (in excess of 36 feet)." Age is considered as important and divers are automatically disqualified when becoming 40 years old. The British Navy (1930) also requires high physical standards and even says, "If the

slightest doubt exists as to the physical fitness of a candidate he should be rejected." According to the British Admiralty (1933) they also require annual medical examination as well as medical examination before each dive.

Abstinence from the use of alcohol has been stressed by most of those writing on prophylaxis. In the United States Navy it is the custom to not only examine before each deep dive but also to take a short history of the previous 24 hours to determine whether there is present an upper respiratory infection, if alcohol has been consumed, if the bowels are moving normally, and if the diver feels fit. No diver is permitted to dive who is not, or does not feel, physically fit.

In summary the written opinion seems to be that careful physical selection of divers is most important, periodic reexamination is essential, medical supervision of pressure operations is desirable, descent or entrance into pressure should be rapid, time under pressure (single or multiple exposures) should be held within safe limits, the stage method of decompression is the method of choice, and that oxygen inhalations and exercise during decompression hasten the elimination of nitrogen.

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NAVAL RESERVE

PROMOTIONS, FOURTH QUARTER, 1937

Clarence Andrew Berger, 3015 Cherry Street, Toledo, Ohio, promoted to commander, MC–V (G), U. S. N. R., November 20, 1937.

Rutherford B. H. Gradwohl, 3514 Lucas Avenue, St. Louis, Mo., promoted to commander, MC–F, U. S. N. R., November 18, 1937.

Joseph Henry Cannon, 104½ Rutledge Avenue, Charleston, S. C., promoted to lieutenant commander, MC–V (S), U. S. N. R., December 17, 1937.

Sam Ardinger Bassett, 1250 Big Bend Boulevard, St. Louis, Mo., promoted to lieutenant, MC–F, U. S. N. R., November 15, 1937.

Charles Bunch, 2214 East Seventh Street, Charlotte, N. C., promoted to lieutenant, MC–V (S), U. S. N. R., November 8, 1937.

Matthew Remey Furman, 230 West Seventy-ninth Street, New York City, N. Y., promoted to lieutenant, MC–V (G), U. S. N. R., November 16, 1937.

Robert Farjeon Legge, 3135 Webster Street, Oakland, Calif., promoted to lieutenant, MC–V (S), U. S. N. R., November 18, 1937.

Duncan Tracy McEwan, Orlando, Fla., promoted to lieutenant, MC–V (G), U. S. N. R., November 9, 1937.

Harry Carpenter Watkins, Jr., Aberdeen, Wash. promoted to lieutenant, MC–F, U. S. N. R., November 12, 1937.

RESIGNATIONS, FOURTH QUARTER, 1937

Moses H. Baker, 6045 Bunkerhill, Pittsburgh, Pa., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted December 2, 1937.

Horace W. Byers, 509 Woodlawn Road, Baltimore, Md., lieutenant commander, MC–V (G), U. S. N. R., resignation accepted October 28, 1937.

Carl E. Dunaway, Huntington Building, Miami, Fla., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted November 19, 1937.

Orion Timberton Finklea, 405–9–16 Florence Trust Building, Florence, S. C., lieutenant, MC–V (S), U. S. N. R., resignation accepted November 5, 1937.

Vonnie Monroe Hicks, Raleigh, N. C., lieutenant, MC–V (S), U. S. N. R., resignation accepted November 4, 1937.

Frank C. Hodges, P. O. Box 1469, Abilene State Hospital, Abilene, Tex., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted November 4, 1937.

Gilbert H. Mankin, 1726 Eye Street NW., Washington, D. C., lieutenant commander, MC–V (G), U. S. N. R., resignation accepted October 28, 1937.

Earl A. Orwig, 2467 Hempstead Avenue, Toledo, Ohio, lieutenant commander, MC–F, U. S. N. R., resignation accepted December 14, 1937.

Samuel B. Potter, Republic Building, Denver, Colo., lieutenant, junior grade, MC–V (S), U. S. N. R., resignation accepted November 2, 1937.

John Hollum Rathbone, 121 East Sixtieth Street, New York City, N. Y., lieutenant, MC–V (S), U. S. N. R., resignation accepted November 4, 1937.

Sydney K. Smith, 230 Grand Avenue, Oakland, Calif., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted November 2, 1937.

Frank W. Smythe, 899 Madison Avenue, Memphis, Tenn., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted December 2, 1937.

Carl G. Swendseen, 603 Syndicate Building, Minneapolis, Minn., lieutenant commander, MC–V (G), U. S. N. R., resignation accepted November 19, 1937.

Charles C. Thomas, 257 Park Avenue, Rochester, N. Y., lieutenant, MC–V (G), U. S. N. R., resignation accepted December 2, 1937.

HONORARY RETIRED LIST, FOURTH QUARTER, 1937

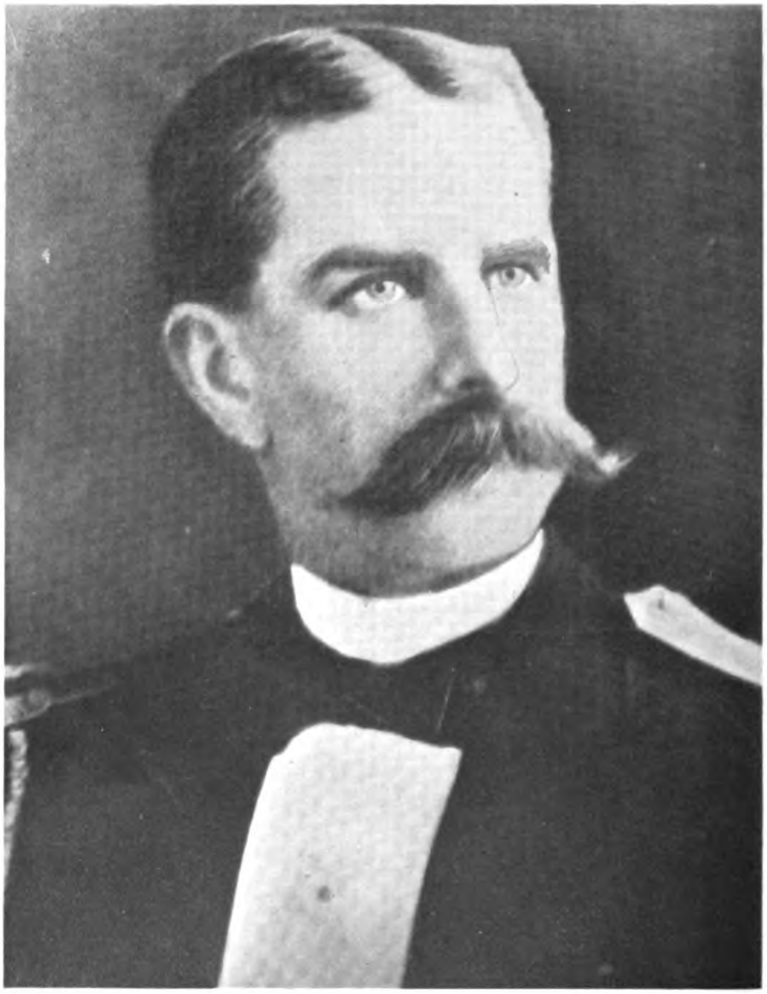
George P. Lingenfelter, 1616 Tremont Place, Denver, Colo., lieutenant commander, MC–V (G), U. S. N. R., honorary retired list December 1, 1937.

William A. Dalton, 243 West Seventieth Street, New York City, N. Y., lieutenant commander, MC–V (S), U. S. N. R., honorary retired list December 1, 1937.

DEATHS, FOURTH QUARTER, 1937

Andrew J. Minaker, 200 Granville Way, San Francisco, Calif., lieutenant commander, MC–V (G), U. S. N. R., died November 22, 1937.

Charles V. Townsend, 101 Dauphin Street, Mobile, Ala., lieutenant, MC–V (S) U. S. N. R., died October 28, 1937.



PRESLEY MARION RIXEY.
Surgeon General, United States Navy, 1902-10.

NOTES AND COMMENTS

PRESLEY MARION RIXEY

By Commander Louis H. Roddis, Medical Corps, United States Navy

The thirteenth Surgeon General, United States Navy, and the seventeenth Chief of the Bureau of Medicine and Surgery, was really the father of the modern Medical Corps of the Navy. He served as Surgeon General from 1902 until 1910, through most of the period during which Theodore Roosevelt was President. A recent naval historian put their relationship and the result of their work as respects the Navy, in the following significant sentences: "Roosevelt was for a great Navy, Rixey was for a fine Medical Department; they were both successful."

Some of the important advances which were made during his term of office included the renovation and modernization of all the naval hospitals, the construction of new ones at Puget Sound (1903), Canacao, P. I. (1903), Las Animas, Colo., for tuberculosis cases (1906), the Naval Hospital, Great Lakes, Ill. (1907), and the Naval Hospital, Guam (1910). He also established the medical supply depots at Brooklyn, San Francisco, and Cavite, P. I., an extremely farsighted provision which during the World War proved of tremendous value and would again be of inestimable benefit during a time of national emergency.

No Surgeon General has been more awake to the needs of the Medical Corps and the Medical Department. Under his regime the strength of the Corps was doubled and he brought to it specialization and postgraduate training. One of his first acts was to establish the Naval Medical School where new medical officers could receive postgraduate instruction in services pertaining particularly to naval medicine. This school is today the only center of naval medicine in the Western Hemisphere, and its library the only important repository of naval and maritime medicine in the New World. He sent medical officers abroad to study tropical medicine, a particular need of the Navy and of the greatest value in the administration of our then newly acquired tropical possessions. He instituted the practice of sending medical officers to important civilian medical institutions for postgraduate training in the leading professional specialties such as surgery, internal medicine; eye, ear, nose, and throat; psychiatry, and the medical sciences. In addition to their special training they brought back to the Navy the latest advances in their profession and

new viewpoints in the prevention and treatment of disease. He established the female Nurse Corps in 1908, these nurses being employed at our naval hospitals, on the hospital ships, and at the nurses training schools for native nurses in our island possessions, as well as in the Hospital Corps training schools. He attempted repeatedly to establish a Dental Corps, and, although this was not done until 1912, his efforts had much to do with its early authorization after his term of office had ended. Under his regime the United States Naval Medical Bulletin was founded (1907). This is a journal devoted to naval medicine, and, again, is the only important one in the Western Hemisphere. The bound volumes of this journal, which has now been published for nearly a third of a century, constitute an important archives of naval medicine. Dr. Rixey's great energy and ability during a long, active, and useful life were devoted to the improvement of the Navy and the making of its medical service something of which the Navy could be proud.

Dr. Rixey was the personal physician of two Presidents. He was the White House physician when President McKinley was struck down by an assassin's bullet. He took entire charge of the care of Mr. McKinley, was present at the operation, and gave untiring professional attention to his distinguished patient. His report of this case constitutes an important medical historical record. He was also the personal physician of President Theodore Roosevelt as well as his trusted and intimate friend.

Admiral Rixey was born at Culpeper, Va., July 14, 1852, and died June 17, 1928. He was commissioned an Assistant Surgeon in the Medical Corps of the Navy on January 28, 1874, his commission being signed by General Grant. He served through all the grades, and was appointed to the office of Surgeon General on February 5, 1902. His term as Surgeon General of the Navy ended February 4, 1910.

In conclusion we may quote the emphatic message of Admiral Dewey addressed to Surgeon General Rixey. "He (Admiral Dewey) especially requested us to inform you that you are not only the best Surgeon General the Navy has ever had, but you have done more for the Medical Department and its development than all of them. He was very emphatic in his praise of you and the most excellent work accomplished by you as Surgeon General of the Navy. It is practically impossible for us to convey his message to you in the same forcible manner in which he expressed himself to us."

INTERNATIONAL CONGRESS ON MILITARY MEDICINE AND PHARMACY[1]

The Bureau of Medicine and Surgery is in receipt of a report on the Ninth International Congress on Military Medicine and Pharmacy held in Bucharest, Rumania, June 1937. The objective and function

[1] Compiled and presented by Capt. William Seaman Bainbridge, M. C.-F., U. S. Naval Reserve (retired). United States delegate to the Congress and member of the permanent committee.

of this organization are tersely stated by Captain Bainbridge as: "So that the lessons of the past war are not lost, and to make them available for any future hostilities, and during peace when virtually every type of wartime injury and disease is ever present, the International Congress of Military Medicine and Pharmacy was created in 1921. There have been meetings of the Congress every other year since then. Its far-reaching importance and eminent value are unchallenged in the minds of those who have come in contact with the work of the organization. Delegates, rich in experience, come from many countries to present their viewpoints. Such an interchange of ideas and knowledge will eventually lead to the physical betterment of mankind."

The permanent committee of the Congress contributes very materially to the success of its meetings and functions as its agent during the interval between sessions. It organizes the Congresses, publishes the International Bulletin of Military Medicine, develops relationships with interested organizations, has organized a Medico-Legal Commission, and has under its International Office of Medico-Military Documentation the duties of sending speakers abroad, replying to international inquiries, arranging conference sessions, and keeping a bibliographic index up to date.

The Congress received official reports from delegates of the nations represented. The following comment presents a very inadequate summary of the material presented in these reports.

Organization and Functioning of the Medical Service in Combined Military and Naval Operations

This report was submitted by Capt. William L. Mann, Medical Corps, United States Navy and Lt. Col. Edgar Erskine Hume, Medical Corps, United States Army, of the United States of America delegation. It deals with regulating the relationship between medical units of land forces and sea forces when they function with a common objective. Cooperation and coordination are the prime requisites for success, and to secure these conditions each medical service must consider the general and special situation and effect complete understanding. Mere cooperation is not enough. The following principles should govern combined operations:

1. There must be unity of medical control.
2. The maintenance of proper liaison rests with the medical service not in actual control.
3. The senior medical officer (administrative) of each medical service is assigned the responsibility of initiating and preparing medical plans and arrangements for submission to superior authority for approval.
4. Medical organizations with their equipment should be maintained and transported intact, insofar as practicable.
5. Measures for prompt relief of human suffering can be rendered more effective by the standardization of material, thus providing mutual logistic support.

6. Common indoctrination of the medical services in medical procedures, arrangements, and practices.
7. For borderline situations supreme medical control should be prearranged.

Standardization of supplies and equipment is essential to permit interchange between land and sea forces at points of embarkation and debarkation. Supplies should be loaded in reverse order to that in which they will be required, so that the last material loaded will be the first available for use. Quarters at ports for troops in transit should conform as nearly as possible with accepted sanitary standards.

On troop transports, all medical organizations and troop functions should be under control of the Navy. Bed accommodations of the sick bay should be computed on the basis of 2 percent of the total number of crew and troops carried, with an additional 1 percent for isolation facilities. While the vessels are en route, if not before, the senior medical officers of the transport and of the troop contingents should be made fully acquainted with all the details of the plan to be followed upon arrival at the destination. Among other matters to be considered by these medical officers and approved by the staffs of the respective services prior to arrival at anchorage, are:

1. The patient capacity of each ship.
2. The types of cases each ship is to receive and retain temporarily during the early stages of the campaign.
3. The adequacy of the medical supplies aboard ship for the patient load to be accommodated.
4. The kinds and quantities of additional supplies that may be needed.
5. How and when such supplies are to be sent aboard at anchorage.
6. The sufficiency of the naval medical personnel aboard, including those to remain afloat during the period of the landing operation.
7. The number and kind of replacements that may be needed in order to care for patients to be allotted to the ship.

The medical units attached to each combatant organization will debark with such organization. The medical regiment will not be landed until the force is fairly well established ashore. Shore hospitals should not be established until warranted by conditions ashore. The first medical supplies sent ashore should be only those necessary under existing conditions for the personnel there. Each unit debarking should leave behind a representative whose sole duty it would be to check, from a specially prepared list, all the property of the unit as it goes ashore.

The casualties should be collected at points at the beach head that will not interfere with disembarking troops. One of the general principles of evacuation is to keep casualties separated from the combat troops. For purposes of morale particular care should be taken to prevent the contact of troops with the unsightly wounded. While waiting evacuation every effort should be made to shelter the casualties from gunfire to prevent shock. Ambulant casualties are apt to

cause considerable difficulty and confusion unless they are closely controlled. The land force's administrative responsibilities cease when it has collected and assembled the casualties on the beach ready for loading. Army medical personnel should, however, assist in the actual loading under the direction of the Navy. A naval medical officer should be attached to the staff of each beach master as medical embarkation officer. He will decide on the time and mode of evacuation by boats to the ship. A naval medical officer should be similarly assigned with the senior army medical officer to assist in proper liaison. The prompt evacuation of casualties from the beach is often a military as well as a humanitarian necessity. Slight and serious cases should not be placed in the same boat.

The sick and wounded of troops while being transported on a naval vessel are subject to Navy regulations and their treatment should be supervised under the direction of the medical officer of the transport. Prior to debarkation all troops should be inspected for vermin and communicable disease and those affected should be segregated, notation made in their health records, and reported to the proper authority at the port of debarkation. Disposition of the sick and wounded on arrival at the port of debarkation is in accordance with the orders of the Commanding General of the port.

Coordination of the medical service of the air forces with that of land and sea forces presents some problems unsolved by actual experience. The same principles as discussed above should govern their solution. Increased use of aircraft for ambulance duty may be anticipated. When used for this purpose they should be manned by noncombatant personnel and the plane should otherwise conform with Geneva Convention provisions.

Space permits only a brief review of the other excellent official reports presented at this Congress.

Transportation, Hospitalization, and Treatment of the Gas Wounded

The question of the transportation, hospitalization, and treatment of those who have been gassed is dominated by the condition and character of the lesions. Their transportation involves no special problem.

It is possible to assure treatment and hospitalization either in a medical formation for the gassed, provided with surgical service, or, in the surgical service, provided with a section for the gassed. As the surgical technic requires a great specialization with adequate equipment and supplies, it would seem that the second is the better solution. If circumstances point to the possibility of a large number of gas wounded, the creation of specialized medical formations for them should be faced. The treatment of toxic poisoning of gassed individuals belongs properly to the Medical Service, whether it is a question of prophylactic measures or other treatment.

Organization and Functioning of the Surgical Service in Motorized Troops

With swift moving motorized units, often isolated and accomplishing difficult duties independently, it is necessary that the attached medico-surgical formations follow at the same speed, and be completely equipped and abundantly provided with supplies, in order to conserve their independence. Cases of urgency will be treated, but in unfavorable tactical situations, the principal activity will consist of rapid mass evacuations to some suitable medical formation. It is especially important that the chiefs of motorized medical formations should have, besides their necessary technical qualifications, adequate military knowledge to enable them to adapt themselves rapidly and without error to the changing conditions of battle.

The Use of Colorimetric Methods of Analysis

Colorimetric methods offer the advantage of often permitting the analysis of minimal quantities of substances, impossible to accomplish by ordinary methods, as is the case in toxicological, biological and even industrial analyses. In order to obviate the inconveniences of colorimetry, the volumo-colorimetric method or that of the photoelectric cell may be adapted, according to the necessities of the case involved.

Edentates in the Armies—Definition—Treatment—Prosthesis; Military Employment in Times of Peace and War

From the military point of view, an edentate is a man whose functional lack of denture is liable to react on his state of general health and diminish his fitness for service. Partial or total loss of the teeth is not a cause for exemption from military service, if it can be effectively compensated for by prosthesis, disregarding all questions of esthetics. The preferable treatment, indispensable from the functional point of view, is the installation of adequate prosthetic equipment, after having put the buccal cavity in good condition by removing septic foci of infection. The artificial denture ought to be made and repaired within the army zone.

A Comparative Study of the Supply of Food Stuffs and the Alimentation of the Sick and Wounded in Times of Peace and War

It is impossible to standardize rations, but it is very desirable to list and classify them. Conditions vary with the economic resources of each country and, above all, with national habits. The alimentation of the sick and wounded ought to benefit by the progress of science and the research in alimentary physiology by giving an important place to protective foods. The preparation and serving of food should be by especially trained personnel provided with modern equipment for conserving and preparing food stuffs.

TENTH CONGRESS MEETS HERE IN 1939

The International Congress of Military Medicine and Pharmacy accepted the cordial invitation of the Government of the United States of America to hold the Tenth Congress here in 1939. The following subjects by title and nation have been selected for study and presentation at the Tenth Congress:

1. Organization and Functioning of the Medical Service in Colonial Expeditions. (Official reporters: Italy—United States of America.)
2. Forecast of War Casualties and Methods of Computation. (Official reporters: Germany—United States of America.)
3. Practical Procedures in Anesthesia and Analgesia in War Surgery. (Official reporters: Brazil—United States of America.)
4. Organization and Functioning of the Military Chemico-Pharmaceutical Service. (Official reporters: Argentine—Czechoslovakia.)
5. Urgency Treatment and Basic Apparatus for Maxillary Fractures in War. (Official reporters: France—United States of America.)
6. Technical Specialization of Administrative Officers in the Medical Service. (Official reporters: Mexico—United States of America.)

CLASSIFIED MATTER

Members of the Medical Department in the performance of their official duty and through their service contacts have frequent occasion to acquire information of a classified nature. It is, therefore, essential that personnel of this department be familiar with the nature of and the regulations governing the custody of classified matter. Careless disregard of these safeguards permits the ever present possibility of compromising the Naval Service.

Classified matter is a generic term used in the Naval Service to compromise matter of a secret, confidential, or restricted nature.

Secret matter is matter of such a nature that its disclosure might endanger the national security, or cause serious injury to the interests or prestige of the nation or any government activity thereof. Information as to the existence, nature, or whereabouts of secret matter shall, except as specifically authorized by the Chief of Naval Operations, be disclosed only to persons in the Government service whose official duties require such knowledge and to persons not in the Government service under conditions of absolute necessity. It is exclusively for the official use of the persons to whom it is divulged and its distribution or dissemination must be confined to the absolute minimum.

Confidential matter is matter of such a nature that its disclosure, while not endangering the national security, would be prejudicial to the interests or prestige of the nation or any government activity thereof. Confidential matter may be disclosed to persons in the Government service who must be informed, and to other persons when, under special circumstances, such disclosure is to the interest of the Navy.

Restricted matter is matter of such a nature that its disclosure should be limited for reasons of administrative privacy; or, is matter not classified as confidential because the benefits to be gained by a lower classification outweigh the value of the additional security obtainable from the higher classification. Restricted matter may be disclosed to persons of discretion in the Government service and to persons not in the Government service under special circumstances when it appears to be in the public interest.

The responsibility for maintaining the proper security of classified matter rests upon each person having custody or knowledge thereof, no matter how obtained. Any person having knowledge or suspicion that secret or confidential matter has been compromised or come to the knowledge of unauthorized persons is required to make a full report of the facts to the Chief of Naval Operations via his commanding officer. In case restricted matter is compromised report shall be made to the administrative head charged with custody of the subject matter who shall take appropriate action. Classified matter shall not be discussed in the presence of persons not authorized to have knowledge thereof. An officer, by virtue of his commission alone, is not authorized to have knowledge of secret or confidential matter. Persons within the Naval Service who receive matter originated by another government agency and designated by that agency as having any degree of confidentiality shall safeguard such matter in the same manner as if it had been so designated by naval authority.

NEW MEMBERS, AMERICAN COLLEGE OF SURGEONS

The Bureau of Medicine and Surgery has been informed that the following naval medical officers have been elected to Fellowship in the American College of Surgeons.

Comdr. Jack S. Terry (M. C.), U. S. N.; Lt. Walter F. James (M. C.), U. S. N.; Lt. Charles R. Wilcox (M. C.), U. S. N.; Lt. William S. Cann (M. C.), U. S. N.; Lt. Warran G. Wieand (M. C.), U. S. N.; Lt. Charles R. Moon (M. C.), U. S. N.

HOSPITALIZATION OF DEPENDENTS

Bureau of Navigation Naval Reserve Bulletin No. 82 of January 15, 1938 states:

The Secretary of the Navy has approved an opinion of the Judge Advocate General that dependents of Naval Reserve and Marine Corps Reserve personnel on active duty may lawfully be hospitalized in certain designated naval hospitals under the same restrictions and conditions in all respects as now apply to the authorized hospitalization of dependents of naval personnel on the active list.

The Chief of the Bureau of Medicine and Surgery will issue appropriate instructions to the several naval hospitals which have been authorized to hospitalize the dependents of naval personnel.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

CLINICAL ALLERGY, by *Louis Tuft, M. D., Chief of Clinic of Allergy and Applied Immunology, Temple University Hospital; Associate in Immunology, Temple University School of Medicine; Director of Laboratories, Pennsylvania Department of Health, Philadelphia,* First edition. 711 pages, illustrated. W. B. Saunders Company, Philadelphia, 1937. Price $8.

The author has written an excellent text on a very interesting, confusing, and important subject. Having reduced the perplexing terms, and what is known about the various phenomena in connection with allergy, to simple understandable and workable language, he has prepared a book which is easy to read as well as easy to understand.

The section on "General principles" is especially well done and would repay any one interested in the subject for the time spent in the study of this section. The various theories of the mechanism of hypersensitiveness have been gathered together and arranged in an orderly manner.

INTRODUCTION TO DERMATOLOGY, by *Richard L. Sutton & Richard L. Sutton, Jr.; Kansas City, Mo.;* Second edition, 566 pages. 190 illustrations. C. V. Mosby Company, St. Louis, Mo. 1937. Price $5.

In the preface to the first edition the author states: "This book is intended primarily for students. We have endeavored to combine judiciously the old and the new, retaining the original lattice work of the fundamental facts which contribute so much to the value of the parent, and omitting much descriptive and statistical matter which is of interest to only the research worker and the specialist." This was admirably done. In the preface of this edition the changes, such as reclassification, additions of new diseases and illustrations with the up-to-date methods of treatment are pointed out.

The first seven chapters are devoted to anatomy, embryology, physiology, general etiology, general symptomatology and pathology,

general diagnosis and treatment. Chapter VIII covers the new classification. Sixteen classes are given. The rest of the book, chapters IX to XXIV, is devoted to a discussion of the various diseases coming under each of the 16 classes. The illustrations are clear and the discussions on etiology, symptomatology, diagnosis, and treatment are to the point. It is an excellent book for the student and general practitioner.

Approved Laboratory Technic Clinical Pathological, Bacteriological, Mycological, Parasitological, Serological, Biochemical and Histological by *John A. Kolmer, M. D., Dr. P. H., LL. D., L. H. D., F. A. C. P.; Professor of Medicine, Temple University and Fred Boerner, V. M. D.; Assistant Professor of Bacteriology, School of Medicine and Graduate School of Medicine, University of Pennsylvania.* Second edition; 893 pages, 12 plates and 380 illustrations. D. Appleton-Century Company, New York and London. 1938. Price $7.50.

The aim of the first edition was to promote the practice of scientific medicine by a wider application of clinical laboratory methods to the diagnosis of disease and to encourage a closer cooperation between the practitioner and the clinical pathologist by the presentation of approved methods covering the field of clinical pathology. That it attained this objective has been amply demonstrated by the wide acceptance and the high regard this excellent text has held.

The second edition represents a complete revision of all chapters in which the many new methods which have been developed and which have proved their value in the past 7 years have been included. Many new figures and illustrations have been added.

In the first edition the technic of the methods given were approved by committees selected from members of the American Society of Clinical Pathologists. In this edition they have been approved by members of a group of 28 collaborators as well as, in many instances, by the authors of the methods themselves.

Approved Laboratory Technic is, in its second edition, again a book no well equipped clinical pathological laboratory will want to be without.

Diseases of the Blood and Atlas of Hematology, by *Roy R. Kracke, M. D., Professor of Bacteriology, Pathology, and Laboratory Diagnosis and by Hortense Elton Garver, M. S., Instructor in Laboratory Diagnosis, both of Emory University School of Medicine,* First edition, 532 pages, illustrated. J. B. Lippencott Co., Philadelphia, 1937. Price $15.

The section of the book dealing with the diseases manifested in the blood is an excellent summation of the current opinion as to etiology, haematological findings, and treatment.

The style in which it is written makes it very readable.

The book contains a section on technique which gives workable tests covering the entire practical field of haematology. The chapter giving the normal blood pictures of the common laboratory animals will be found useful.

In short, the Atlas completely covers the morphology of blood cells. In the matter of illustration, however, it must be noted that the nuclear details are somewhat schematic and the colors are not quite true reflections of the usual Wright's strain.

It is to be regretted that so excellent a text should not have a binding of corresponding quality.

Atlas of Hematology, by *Edwin E. Osgood, M. A., M. D., Assistant Professor of Medicine and Head of Experimental Medicine and by Clarice M. Ashworth, Medical Illustrator, both of the University of Oregon,* First edition, 225 pages, illustrated. J. W. Stacey, Inc., San Francisco, 1937. Price $15.

Upon examination of this book one is immediately favorably impressed by the excellent quality of its binding and paper. As the title states, it is truly an Atlas of Hematology, profusely illustrated with colored plates. True shades of colors are extremely difficult to reproduce, and, as a whole, the plates in this volume are the best that we have seen to date.

While there was no intention upon the part of the authors to make the book a text of hematology, it nevertheless contains numerous useful differential diagnostic tables, excellent descriptions of most of the blood dyscrasias, and a section on hematological technique. It is well indexed, and the same identification numbers of the cells on the colored plates are used in the descriptive matter throughout the book.

Unfortunately several new names for cells have been introduced by the authors in place of the ones in common use, thus tending to further confuse an already overburdened nomenclature. However this does not detract from the value of the Atlas.

Any laboratory worker dealing with hematological problems will find this book invaluable, particularly in the identification of blood cells, although, contrary to the author's system for cell identification, no degree of experience will permit one to claim that he is capable of designating the type to which every immature cell belongs.

A comprehensive list of references is given.

The Cerebrospinal Fluid, By *H. Houston Merritt, M. D., Assistant Professor of Neurology, Harvard Medical School; Director of the Cerebrospinal Fluid Laboratory, Boston City Hospital; and Frank Fremont-Smith, M. D., formerly Assistant Professor of Neuropathology, Harvard Medical School; formerly Director of the Cerebrospinal Fluid Laboratory, Boston City Hospital. With a foreword by James B. Ayer, M. D.,* Octavo of 333 pages, illustrated. W. B. Saunders, Co., Philadelphia. 1937. Cloth, Price $5.

This new book is based on 21,000 spinal fluid examinations done by the authors, together with 1,000 especially selected fluids from Dr. James B. Ayer's laboratory at the Massachusetts General Hospital.

The chapters include anatomy, physiology, chemistry, and pathologic physiology, technic of lumbar and cistern puncture, routine examination of the fluid, cerebrospinal syndromes, therapeutic use of

lumbar puncture, roentgenography of the ventriculosubarachnoid space, and methods of spinal fluid examination.

The chapter on spinal fluid syndromes takes up 115 diseases and conditions. This chapter alone is well worth the price of the book. An exceptionally fine bibliography is furnished.

CLINICAL URINALYSIS AND ITS INTERPRETATION, by *Robert A. Kilduffe, A. M., M. D., F. A. S. C. P.; Director of Laboratories, Atlantic City Hospital.* 428 pages and 40 illustrations. F. A. Davis Co., Philadelphia. 1937. Price, $4.

This book, by a master clinical pathologist, covers the field of urine examinations for clinical purposes in a most complete and satisfactory manner. Practical proven methods have been selected for each test or examination; alternates are given where it would seem advisable. Technic in each case has been completely detailed. Interpretation is briefly and clearly given. Especially valuable for the physician or technician in this field will be found the fact that the inherent fallacies of methods are pointed out and the possible causes of false and misleading results given.

The book will be found a most valuable tool in the clinical urinalysis laboratory.

EMBRYOLOGY, by *Harvey Ernest Jordan, A. M., Ph. D., Professor of Histology and Embryology and by James Ernest Kindred, M. A., Ph. D., Associate Professor of Histology and Embryology, both of the University of Virginia.* Third edition, 613 pages, Illustrated. D. Appleton-Century Company, Inc., New York. 1937. Price, $7.

This book is primarily a student's textbook of embryology, for which purpose the subject matter is excellently presented and well arranged. There is included a most useful chapter of laboratory exercises. It is almost needless to say that any physician at times will find it necessary to refresh his memory of embryology and, upon such occasions, will find this book of value.

The chapters dealing with teratology, the recapitulation theory, or the so-called biogenetic law, and eugenics touch so lightly upon these subjects that they might well have been omitted.

The chapter on sex determination and that part of the one on teratology, concerning twinning, are of general interest.

The book contains 504 illustrations, most of which are schematic.

The volume is well bound and printed.

DISEASES OF THE NOSE AND THROAT, by *Sir St. Clair Thomson, M. D., F. R. C. P., Lond., F. R. C. S. Eng., L. L. D. (Hon.) Winnipeg, Medicine diplomé en Suisse and V. E. Negus, M. S. Lond., F. R. C. S. Eng.;* fourth edition revised; Buckram, 920 pages, 386 figures, 13 color and 16 radiographic plates, Index. D. Appleton-Century Company, Inc., New York. 1937. Price. $14.

This fourth edition (first in 1911) by Thomson with the cooperation of Negus, has modernized what has been described by Chevalier Jackson as, "the greatest textbook on nose and throat ever published."

It expresses not only the experience of the authors in minute detail but also gives the opinion of world-wide authorities, as quoted or set down in the footnotes of nearly every page. This and a complete bibliography makes the book an excellent reference. Clarity of description and concise presentation provide a veritable storehouse of knowledge of diseases of the nose and throat in a very readable form.

The contents are divided into 15 parts, namely: Introduction, diseases of the nose, diseases of the accessory sinuses (paranasal sinus diseases), tumors of the nose and accessory sinuses, diseases of the nasopharynx, diseases of the pharynx and tonsils, diseases of the larynx, diseases of the trachea and bronchi, diseases of the oesophagus, chronic infective diseases, acute specific fevers in the nose and throat, the nose and throat in some general affections, foreign bodies, peoral endoscopy, some operations, and formulae. Each of these 15 parts has its subdivisions, the whole subject being related in 61 chapters. There is an excellent index of 56 pages.

In his preface to the third edition the author quoted Samuel Johnson's Preface to his Dictionary of the English Language, 1775, as follows: "In this work, when it shall be found that much is omitted, let it not be forgotten that much likewise is performed." Again, in his preface to the fourth edition Sir St. Clair quotes Bacon, "Were it not better far for a man in a fair room to set up one great light, than to go about with a rush light into every dark corner?" In ending his preface to this edition he concludes, "My task has consisted chiefly in trying to exercise the right judgment which we all pray for in all things, no easy matter in medicine, even after 55 years of practice, of which 44 have been entirely devoted to laryngology." Any student after reading this book will feel that the author has fulfilled his ideals and "well done" can be applied to the completion of his task.

Practical Methods in the Diagnosis and Treatment of Venereal Diseases, by *David Lees, Third edition, edited and reviesd by Robert Lees, M. B., F. R. C. P. (Edinbourgh)*. Cloth, 608 pages, 85 illustrations, appendix on pharmacopoeia, index. William Wood & Co., Baltimore, Md. 1937. Price $5.

The subject of venereal diseases, from a clinical point of view, is well and extensively covered. The colored plates and illustrations should be of value to the medical practitioner and student.

On page 220, the following statement is made relative to the treatment of syphilis: "There appears to be little essential difference between 'continuous' treatment, and 'intermittent' treatment in which the drugs are given in a series of injections with a rest interval between courses." This is not in agreement with the finding of the cooperative clinical group of this country. This group found continuous treatment to be the most efficient method. On page 330,

the author gives a good evaluation of the complement fixation test in gonorrhea. From the text following this evaluation, one is apt to get the impression of more importance being placed on the test than is justified from the evaluation. In the treatment of gonorrhea, especially its complications, emphasis is placed on the value of vaccine therapy. This should be taken as an opinion of the author and not as an entirely accepted fact.

THE TREATMENT OF GONORRHEA AND ITS COMPLICATIONS IN MEN AND WOMEN, by *William J. Robinson, M. D.*, Fourth edition enlarged. 331 pages. Eugenics Publishing Co., Inc., New York, N. Y. 1933. Price $3.

The author states in the Preface: "The book is distinctly a personal book, and represents how Dr. Robinson treats gonorrhea and its complications and not how A., B., and C. treat them." This thought is carried through the entire text and this reviewer is of the opinion that exaggerated emphasis of this thought detracts from some of the valuable information contained therein. According to the title the book was written for the general practitioner. However, the uninitiated in this specialty should read the text critically and accept the author's statements cautiously. For instance, after giving a good description of making a proper smear and staining with Loeffler's solution of methylene blue the following statement is made: "And if the typical diplococci are present, the patient presents the ordinary history and symptomatology of gonorrhea, the diagnosis is settled, and no further investigations are necessary."

THE DIVISION OF PREVENTIVE MEDICINE

Commander O. S. Stephenson, Medical Corps, United States Navy, in charge

UNITED STATES NAVY SUBMARINE SERVICE [1]

By W. C. Harrison, New York Life Insurance Company, New York, N. Y.

It is to John P. Holland, who launched his first boat in 1875, that credit is given by the authorities for bringing the submarine to its present state of practical value. The earlier diving boats of the Holland type had a reserve buoyancy of only about 6 percent, which meant that they practically ran awash in the surface position. These early level-keel torpedo boats were designed wholly for under water work and made shallow dives by means of horizontal rudders. Later the submersible type was developed. This was characterized by a reserve buoyancy of 30 to 40 percent permitting more rapid and steeper dives. Such distinctions are not applied in the present-day submarines, as these two types have been modified now by merging into one type the level keel and reserve buoyancy submerging principles.

Holland boat, No. 9, known as the *Holland* built and thoroughly tested over a 2-year period, 1898-1900, was the first submersible combining these two principles. When turned over to the Navy, it proved to be the first really practical submarine and served as a model for the early American and British submarines. The boat was 53 feet in length, 11 feet wide at midship, had a single propeller and usual stern diving rudders. It was driven by gasoline motor on the surface, and batteries when below water. This boat utilized for the first time the principle of dividing the ballast tanks into compartments permitting better handling. Surface cruising radius was 1,500 miles; while submerged, about 40 miles. As no periscopes were available the boat was brought to the surface for observations. It had no clinometers to determine the diving angle, this device being invented in the next year, however. Another device originating in this boat was the compensating tank, which filled immediately when a torpedo was discharged. It is interesting to know that the building,

[1] Editors Note.—This article in original form was not written for the service. It has been edited with apology to the author, by eliminating some historical material and items of less interest to the Bulletin readers.

operating, and testing of these nine experimental Holland boats were completed with no serious accident, and no loss of life.

In preparation for the first fleet of submarines for our Navy, another experimental boat named the *Fulton* was constructed by Holland. Based on this craft the first submarine flotilla was constructed in 1903, composed of seven submarines, the *Adder*, *Moccasin*, *Porpoise*, *Shark*, *Grampus*, *Pike* and the reconstructed *Plunger* (Holland No. 7). These boats incorporated the first early form of periscope. The average length of these boats was 65 feet, with submerged displacement of 120 tons.

In 1905 three more submarines of 170 tons, known as the B class were added. The *Octopus*, first of the C class boats, was launched in 1906 and was considerably larger being 105 feet long and 270 tons displacement. This craft was tested at 200 feet depth, the first submarine to withstand this pressure and also remained under water for 24 hours with full crew aboard. The B boats and the *Octopus* comprising the second flotilla of the Navy were the last to use gasoline, the Government requiring Deisel engines in later boats to eliminate danger from gasoline, and resulting in a doubling of the radius of action because of the fact that with the heavier fuel the number of horsepower-hours was twice that from a like quantity of gasoline.

The third flotilla was comprised of four boats of the C type and three of the D class, accepted in 1909. This last class registered a further advance, being 340 tons submerged. These boats accomplished a submerged run of 150 miles, coming to the surface at night to recharge. One of these made the first open sea trip of 1,500 knots from Boston to Bermuda and back under its own power. From 1909 to 1912 six additional submarines were acquired, the two E boats *Skipjack* and *Sturgeon* and the F–1 to F–4. Great improvements had been made and although submarines seldom travel at a depth of more than 100 feet, they are built to stand 200 feet of pressure with a safety factor of two, yet the F–1 made a cruise of 6 hours at a depth of 283 feet. In these last boats the displacement had increased to 550 tons, the surface speed to 14 knots and the underwater maximum to 10 knots. These submarines were divided with bulkheads, had 4 torpedo tubes and a 4-inch gun on the superstructure.

During the next few years the G, H, and K series of submarines were built. These were the submarines used in the World War and their operations extended over both oceans. They were sold, dismantled, or otherwise put out of commission in 1922.

The somewhat larger boats designated as the L series were also employed during the World War. The R series came next and included some 30 boats, a few of which were constructed in time to see some service in the war. This series has practically been decommis-

sioned with the exception of six which are now used at New London for training purposes. Between 1919 and 1922 some 50 boats of the S series were built and added to the service. They average 1,000 tons displacement and are powered by twin engines of approximately 1,000 horsepower each.

The latest and largest of the submarines, the V type such as the *Cachalot*, *Narwhal*, etc., are from 260 to 370 feet long and with displacement of 1,700 tons to 4,000 tons. The power plant comprises four Diesel engines installed in each boat totaling some 8,000 horsepower. The Diesel engine has made possible the development of the submarine and conversely the necessity of building lightweight, high-speed Diesels for submarines has been a great factor in bringing this type of engine to its present compactness and reliability. The old marine standard of some 200 revolutions per minute has been increased by the Diesel engine in submarines to 600 revolutions per minute.

To summarize, we find the Navy now (as of July 1, 1936) possesses 87 submarines. Six are of the fleet cruiser type. These are the largest submarines in our Navy and average 350 feet in length with 2,700 average tons displacement. This tonnage represents the total displacement when submerged. They mount two 6-inch guns and have six torpedo tubes. These boats are expected to accompany the battle fleet. They must, therefore, possess seaworthy qualities of a fairly high order, have good habitability, excellent surface speed, and a large radius of action, though fuel supplies could be obtained from the surface vessels, preferably from auxiliaries. Included in this group is the mine-laying submarine *Argonaut*, which together with its guns and torpedoes, also carries mines.

The next group in size is made up of cruising submarines which run from 800 to 1,600 tons. They are large enough to remain at sea for a month or two and operate independently for long distances from bases. These boats generally carry 4 officers and a crew of from 35 to 50 men.

The smaller submarines, 30 in number, average 600 tons, carry an average crew of 3 officers and 30 men, and are generally assigned to coast defense. They are designed to operate from a base which is near at hand so that the cruising radius and habitability can be sacrificed without loss of efficiency. There are no quarters for officers or crew, all possible space being devoted to machinery and torpedoes.

As an indication of the rapid growth of submarining from 1900, when only a few experimental craft were in existence, to 1914, the

first war year, and with further comparison to July 1936 the following figures for the various navies are illuminating:

	War submarines July 1914		Lost during war	As of July 1936	
	Built	Building		Built	Building
United States	44	31	0	87	12
Great Britain	75	22	54	60	15
France	64	22	14	80	6
Japan	13	2	0	55	8
Russia	30	19	20	60	20
Italy	19	8	8	72	12
Germany	27	18	203	22	14

From 1900 to the opening year of the World War (1917, United States; 1914, other powers) the following submarine disasters have occurred where lives were lost or injuries sustained. (Figures in parentheses are injuries.)

Date	Submarine	Owned by—	Deaths and injuries	Cause
1902	Fulton	United States	(4)	Battery gas explosion.
1903	A-1	British	(6)	Gas explosion due to motor.
1904	do	do	11	Collision due to faulty periscope. First major submarine disaster.
1904	Delphine	Russia	23	Swamped by swells from passing steamer entering open hatch.
1905	A-5	British	4 (7)	Gasoline explosion through neglect of closing vents when filling tank.
1905	A-8	do	14	Sudden dive and filling through open hatch.
1905	Farfudet	French	14	Foundered by water entering open hatch.
1906	Lutin	do	13	Sank stern first. Sprung leak in hull.
1909	Foca	Italian	13	Gas explosion, sparking motors.
1909	Kambola	Russian	20	Collision with battleship.
1909	C-11	British	13	Collision at night.
1910	No. 6	Japan	14	Sluice-valve mechanism broke.
1910	Pluviose	French	26	Collision, periscope not adequate.
1911	U-3	German	3	Ventilator left open; 27 men aboard, all but 3 escaped through torpedo tubes.
1912	A-3	British	14	Collision.
1912	Vendemaire	French	24	Collision. Run down while emerging.
1912	B-2	British	15	Collision at night.
1913	E-5	do	3	Battery explosion.
1914	A-7	do	11	Exceeding critical speed on surface caused plunge.
1915	F-4	United States	21	Battery corrosion; chlorine explosion.

For over 15 years the submarine forces of our Navy operated without a serious catastrophe in great contrast to the records of other navies. The loss of the *F–4* during underwater maneuvering near Honolulu Harbor was caused through corrosion of the lead lining of the batteries permitting the acid to weaken rivets in the side of the ship. The sea water entered, evolving chlorine gas by reaction with battery acid, causing an explosion which admitted more water. Rigorous inspection and adequate equipment have prevented the recurrence of this type of accident, the only one of its kind recorded over a 36-year period in our submarines.

From 1919 through 1936 the following peacetime submarine accidents have occurred. (Figures in parentheses injuries.)

Date	Submarine	Owned by—	Deaths and injuries	Cause
1921	K-5	British	57	Lost on a dive.
1922	H-42	do	23	Collision.
1923		Japanese	85	New boat lost during undersea maneuvering.
1923	O-5	United States	3	Collision.
1924	L-24	British	23	Do.
1925	Veniero	Italian	50	Unknown.
1925	S-51	United States	33	Collision.
1925	M-1	British	68	Do.
1926	H-29	do	6	Misunderstood order resulted in incorrect handling of submarine apparatus.
1927	S-4	United States	38	Collision.
1928	F-14	Italian	31	Do.
1928	Ondine	French	43	Do.
1929	H-47	British	21	Collision with submarine L-12.
1931	No. 9	Russian	35	Unknown.
1931	Poseidon	British	20	Collision with Chinese merchant steamer "Yuta" in China waters; 35 men were saved, some by using the submarine "lung."
1932	M-2	do	60	Lost on dive—cause unknown.
1932	Promethee	French	62	Lost off Cherbourg during under-water maneuvers.
1932	Persee	do	2 (27)	Explosion.
1933	L-26	British	2 (19)	Explosion and fire.
1934	Ariane	French	(12)	Explosion.
1934	Nautilus	United States	(11)	Crankshaft explosion.
1935	B-3	Russian	55	Collision with warship.
1936	U-18	German	8	Sank during torpedo practice.

The submarines generally operate from four main bases: New London, Conn.; Coco Solo, C. Z.; the Hawaiian base at Pearl Harbor, and in Asiatic waters from Cavite, P. I. There are, of course, other naval bases both in this country and in Asiatic waters from which our boats may operate. The policy of the Navy high command, however, is to use these four bases as headquarters for the several submarine divisions and squadrons.

The base at New London is used as a training school and has 7 submarines with 30 officers and 195 men. Other craft located here relating to submarine work are the U. S. S. *Falcon* and U. S. S. *Sommes* which are submarine salvage and rescue vessels whose officers and men are engaged in diving and salvage work not strictly submarine duty. There is also a mine depot and torpedo school here, an activity not necessarily involving submarine duty.

At the Coco Solo base there are 6 submarines with a personnel of 30 officers and 240 men. There are also rescue vessels and miscellaneous craft for service to submarines.

The largest fleet of submarines is stationed at Pearl Harbor in the Hawaiian Islands. Thirty submarines are stationed here, the force allotted being 76 officers and some 1,500 men. Most of the experimental work in submarine rescue and efficiency is carried on here due to the favorable factors of the comparative warmth and calmness of the adjacent waters. A complete equipment of a large dry dock,

rescue and experimental vessels, diving tank, and training school, make this station one of the largest and most thoroughly equipped submarine bases in the world.

The Asiatic squadron of 6 submarines manned by 25 officers and 228 men work from the base at Cavite just outside Manila.

The above location of the submarine personnel brings to our attention the fact that this duty requires practically all the men in the service to be stationed for periods in tropical ports. This fact need not be unduly stressed, however, as most of the men are in the Hawaiian Islands where, of course, no real tropical conditions apply. Real tropical conditions are prevalent at Coco Solo and Cavite where men generally stay for 2 years only.

Submarines are either single, or double hulled. In general, the single-hull type submerges more quickly, the double hull is heavier and costs much more. The single type hull is now limited to the smallest submarines, the double type to the largest, while the intermediate size has a partial double hull. In the single hull type of submarine, the ballast tanks are located inside the hull, whereas in the double-hull type, the space between the two hulls is used for ballast tanks. By the removal of these ballast tanks from inside, the double hull type has increased capacity for other purposes. In addition, better speed for surface propulsion and added seaworthiness are attained from the better shape of the outer hull. On the earlier submarines there were no watertight subdivisions. On the later types the hull is subdivided to the maximum extent, experience having proved the value of the feature in case of accident.

The superstructure consists of a light structure built above the outer hull. Cable holders, boats, and other equipment are stored here because they would bring undue resistance when submerged were they not housed. This superstructure is also fitted with a deck including a raised portion amidships which is used for a navigating bridge. This is reached from inside the submarine by a conning tower. The superstructure is generally "free flooding," that is, it is flooded and vented when submerged through open holes along its sides, the air escaping through numerous holes in the superstructure deck.

The periscope, or eyes of the submarine, projects up through the conning tower. Before 1902, when the periscope was first introduced, submarines had to come to the surface to do their navigating. In those days the circular tower, as it was called, was fitted with glass windows around its circumference. Then came the periscope consisting of a long tube with a window and a glass prism at the top and a similar arrangement at the bottom. Various lenses are fitted in the tube to increase the strength of the image. By rotating the periscope the entire horizon can be scanned. Today's submarines carry two and sometimes three periscopes, some of them 35 feet long. The use of

aircraft in fighting submarines has made it necessary to fit periscopes with a prism which will give a vertical view as well as a horizontal one.

In order to submerge the modern submarine several tanks known as "main ballast tanks" are completely flooded. Since these filled tanks sink the vessel from the surface to under water, their total volume is the reserve of buoyancy of the submarine when on the surface, hence is a measure of her seaworthiness. To maintain proper balance and buoyancy lost through the consumption of fuel oil, shells, and torpedoes, auxiliary ballast or compensating tanks are provided.

The main ballast tanks are the most important since their filling destroys all positive buoyancy. There is a valve at the bottom for entry or exit of water; a vent-valve at the top for the escape of air; a pipe through which the compressed air enters the tank and drives out the water. Some tanks also have drain pipes for emptying by pumping. Modern warfare necessitates quick submersion so these valves have been increased until 1 or 2 minutes is generally sufficient to put the submarine below the surface.

The compressed air for blowing tanks and for torpedo service is stored in reservoirs, or air bottles at 2,500 pounds per square inch. The reservoir capacity varies, but is in the neighborhood of 3 cubic feet and this compressed air is sufficient to blow the ballast tanks three times. At least two motor-driven pumps, capable of pumping against any pressure, up to the pressure at the greatest depth the ship is designed to navigate, are also provided.

After the submarine is submerged, the batteries supply current to the motors for propulsion. Their batteries are of the lead pasted type. In small submarines, two batteries of 55 to 60 cells are installed and in the larger, two or three of 110 to 120 cells each. For convenience and transfer, the cell containers have standardized dimensions. When the battery is being charged, hydrogen is evolved and to obviate explosions, exhaust fans discharge this into the open. All charging is done either at the base, or while running on the surface.

Safety Measures and Devices

Medical supervision.—Officers and enlisted men who are candidates for submarine service are given a careful physical examination, as detailed in the Manual of the Medical Department, paying special attention to the conditions which are cause for rejection.

The medical officer attached to submarine activities makes periodical inspections and examinations of the submarine and its personnel, and he accompanies the submarine occasionally to observe the function of personnel and matériel. He checks on ventilation of the submarine under: (1) Surface conditions. The adequacy of air supply to all compartments when cruising on the surface with all hatches closed, except the conning tower. (2) Submerged conditions. Air purification apparatus. Depending on the size of the boat and personnel, air

purification will be required after a definite period, the upper limits of CO_2 being set at 2 percent. The hydrogen detector supplied to each submarine is used under conditions of exceptionally long submergences and during and after charging the batteries. About 4 percent hydrogen in the air is considered the critical point. In view of the physical requirements and medical care, there can be no doubt but that this group is a select one and under the most rigorous health supervision.

Submarine escape appliance.—Safety devices on a modern submarine are many and varied. Safety devices come under the cognizance of the Bureau of Construction and Repair. This Bureau and its publications, especially its manual and circular letters, should be consulted for the latest information relative to safety regulations and appliances. In 1928 a special Navy board was appointed to study these safety measures and reviewed in the neighborhood of 5,000 suggestions. The most valuable device in the opinion of the board is the Momsen submarine "lung." This is in effect a miniature diving apparatus which, when worn, permits the wearer to rise safely from a sunken submarine without danger of suffocating or drowning. Training and experiments with this lung are carried out at Washington, D. C., Navy Yard in a vertical cylindrical diving tank, 10 feet 1 inch in height and 9 feet 10 inches in diameter with walls of 2-inch steel, tested to a pressure of 400 pounds per square inch. When in use the tank is filled with water to a height of 8 feet to allow an air pocket above the water. It is fitted with an airtight hatch on the upper end which opens downward into the tank. There are six 4.5-inch ports in the side for observation purposes. The tank on the inside is well lighted by electric lights and is equipped with loudspeakers and telephone. The men are exposed in the diving tank to air pressures equal to various depths of sea water. During the exposure time they breathe in the air pocket and exercise by swimming in the water. Prior to the end of the exposure the man puts on the submarine escape appliance, charges it with oxygen or air, submerges completely in the water and breathes into the appliance for 2 minutes after which ascent is simulated at the rate of 50 feet per minute by reduction of air pressure. It should be borne in mind, however, that experimental work is done only by the Experimental Division, and that men studying for submarine assignment at New London and Pearl Harbor do no experimental work with this apparatus. All they are given is enough training to familiarize themselves with this escape lung.

Training tanks.—The diving tanks and training of submarine personnel at New London and Pearl Harbor is described in the following official report:

The training tank is a structure about 130 feet in height and 18 feet in diameter. It is filled with heated salt water. Escape locks are located at points 18 and 50 feet from the top. A cylinder at the bottom of the tank represents a submarine compartment with standard door for entering and a standard hatch for escaping.

At the top a diving bell is suspended by a wire cable. The bell is operated by an electric motor so that it can be raised or lowered in the water. Its capacity is three men. Normally two men and an instructor go down in the bell to the desired depth when the men are sent out to practice the escape.

The student first goes into the decompression chamber and is subjected to a pressure of 50 pounds. Men with sinus trouble, chronic ear disease are usually eliminated at this stage, having to come out before the first atmosphere or 14 pounds, is reached. Should the man not be able to stand the pressure he is eliminated at this stage. After passing this test the student is taken to the top of the tank and learns to use the lung by practising on the ladders, which extend about 15 feet into the water from the top of the tank. When he has done this to the satisfaction of the instructors, he is taken down to a depth of 10 feet in the diving bell and escapes up a line to the surface.

After completing this, he is taken down in the bell to a depth of 18 or 20 feet or into the 18-foot lock, and escapes up a line to the surface, making one stop on the way up. At the present time the applicant for submarine qualification is only required to make two 18-foot escapes. If the man wishes he may take further training at the 50-foot and 100-foot depth. If so two 50-foot escapes are next made, either from the diving bell or the 50-foot lock. In coming up from this depth he makes three stops, the first at 30 feet, where he counts 10 breaths, at 20 feet, for 20 breaths, at 10 feet for 30 breaths, and then to the surface. This amount of decompression is not necessary at this depth, but it is given as practice for the next step, which is 100 feet. When ready for the 100-foot escape, the man goes into the 100-foot compartment and escapes up a line to the surface, making the same stops as in coming up from 50 feet.

Since training with the submarine escape apparatus was instituted there have been two fatalities directly or indirectly attributable to this training. One case, a quartermaster, first class, 24 years of age, occurred while undergoing instruction at Pearl Harbor in May 1930. During the morning the man made two descents to depths of 7 and 15 feet, respectively. On the third escape the diving bell was submerged to 28 feet with pressure within of about 12.4 pounds. The length of time required for the descent of the bell and in the inflation of the lung by the man preparatory to emerging was approximately 5½ minutes. The other fatality occurred on May 22, 1931, at San Diego, Calif. In this case the deceased made an escape from a depth of 15 feet in 3 seconds. After appearing on the surface he closed the shut-off valve and reached the ladder to ascend the float, but was unable to grasp it. On being rescued he breathed a few times and expired.

It is the consensus of opinion among authorities that exposure to 1 atmosphere gage or 33 feet of sea water does not involve any danger of caisson disease even with unlimited exposure. The standard diving tables do not prescribe decompression even for 42 feet if the exposure does not exceed 3 hours. The above-mentioned fatalities cannot, therefore, be ascribed to caisson disease. Lt. Comdr. I. B. Polak, Medical Corps, United States Navy, discusses the causes of accidents which occurr in submarine escape training as follows:

Etiology

(1) The symptoms and fatalities resulting during lung training are not due to failure of the right ventricle from inability to cope with high pulmonary blood pressure. (2) Increased intrapulmonic pressures causing overdistention of the lungs, sufficient to rupture alveolar walls, are the factors concerned in the production of air embolism. (3) Air emboli originating in the pulmonary circulation are carried to the left side of the heart and then distributed through the systemic circulation. This alone is the cause for the accidents that have occurred. (4) Severity of the symptoms from air embolism depend on the amount of air in the circulation and the vital areas involved. (5) Position of the body determines the distribution of these emboli. (6) Under experimental conditions in animals and under natural conditions in man air embolism can be prevented, except under extremely abnormal conditions of pressure, by limiting the chest distention.

Prevention

(1) All men being trained in the use of the submarine escape apparatus should become thoroughly familiar with the problem of breathing while wearing the "lung" under water prior to attempting an escape. (2) It should be emphasized that continuous and rapid breathing must go on during the ascent. (3) The men should be completely familiar with the method and purpose of venting the "lung" through the flutter valve.

Treatment

(1) Absolute rest with the body in moderate head-down position. Warmth. (2) Immediate compression to at least 6 atmospheres gage. (3) Artificial respiration. If necessary oxygen CO^2 inhalation may be used. (4) Intravenous adrenalin 0.5 cubic centimeters physiological saline.

Submarine escape chambers.—All submarines are fitted with two escape chambers which are built in fore and aft and rise from the floor of the ship to the outer casing, through which a hatch opens directly to the sea. There are two escape lungs supplied each man on a submarine one at each end of the boat. The method of escape from a sunken submarine as outlined by Lt. C. W. Shilling, Medical Corps, United States Navy is as follows:

(1) The "lungs" are distributed individually and tested for working condition. (2) The "hatch skirt" is then placed in position under the escape hatch so that an air pocket may be maintained. The newer type submarines have the "hatch skirt" permanently attached. (3) The hatch is undogged so that it will spring open when the external and internal pressures become equal. (4) Flooding the compartment with sea water is now started and continued rapidly until the inside pressure equals the external pressure at which time the hatch opens and water pours in and air escapes until the level of the water in the compartment reaches the lower edge of the "shirt," air above the water level in the compartment thus being trapped. (5) A buoy carrying a line is released and when it reaches the surface the end of the line in the submarine is secured. (6) The "lung" is now charged with oxygen, the individual ducks under the edge of the "shirt" and grasping the line slides slowly up through the hatch to the surface.

It is evident that a hazard of caisson disease is incurred under this condition of continuous ascent. A study was undertaken to determine how long an individual could remain at a given depth, as in a submarine during preparation, flooding,

and escape described above, and then make continuous ascent to the surface, at the rate of 50 feet per minute, without developing caisson disease. As a result of this study "it was found safe under experimental conditions to remain 37 minutes at a simulated depth of 100 feet, 18 minutes at 150 feet, 17 minutes at 167 feet, 14 minutes at 185 feet, and 13 minutes at 200 feet, the subjects coming to the surface at the rate of 50 feet per minute."

Other safety devices and appliances.—Another safety measure is that salvage air connections to ballast tanks and all compartments are permanently located on the deck of the submarine. This enables divers to make the proper connections easily and "blow" the submarine to the surface.

A large closed pressure "bell" is part of the equipment of Navy salvage ships. This rescue chamber can be lowered to the sunken submarine where contact is completed and the men may be taken out through the motor room hatch or the torpedo room hatch.

Each compartment of a submarine is supplied with a high-pressure air cock so that the compartment struck will have available all of the ship's high-pressure air to help hold the water out while repairs or plugging of the hole is attempted. Quick-closing doors are provided so as to rapidly isolate the damaged section.

Pontoons are available at each submarine base for the raising of a sunken submarine which cannot be raised by the blowing in of salvage air.

Buoys are carried by the submarine which may be released from inside the ship. This buoy carries a telephone cable for communication with the surface. It would prove of material aid in the location of a sunken submarine. Signal bombs are also carried in connection with this device.

Sound devices for the detection of an approaching ship or obstruction are built in on all our submarines. For shore or longer range communication the antennae must be above the surface and the wireless used.

Two types of gas masks are provided the men aboard all submarines, one chlorine gas mask and one general protective mask. Duplicates are placed at each end of the ship. Chlorine only escapes when salt water comes in contact with the batteries which can only occur in the event of an accident to the boat. No special chlorine detector is used or needed as the odor is so characteristic that it would be immediately noted.

A hydrogen detector is permanently located in each of the two battery compartments. It is run constantly during the charging of the batteries.

A CO_2 detector, known as the Higgins-Marriott is supplied to every submarine and the men are all qualified in its use.

Training and Submarine Service Requirements

Department records show that the average duration of continuous service on submarine for officers is approximately 5 years. There is no set limit as to the time an officer or enlisted man may spend on submarine work. The desire of all-around experience on other types of vessels, however, generally so acts as to limit his submarine-service time to this 5-year period. The average age for this group is indicated by the facts that of the 1936 personnel of 302 officers, 76 were lieutenants with an average age of 34 or 35 years, and 189 lieutenants, junior grade, with an average age of 28 or 29 years. These two ranks comprise approximately 90 percent of the officers attached to submarine duty.

Officers after volunteering are ordered to the submarine school at New London for a 6-months' period of instruction. Then they are assigned to a submarine where they must serve aboard for a period of 1 year, not counting navy yard overhaul periods, before they are eligible for examination for submarine qualification. Apparently officers of the rank of lieutenant, junior grade, are in the great majority in applying for this training. Torpedo instruction is given at New London.

After an officer is qualified he will spend 3 years on submarine sea duty between the intervals of shore duty. When an officer qualified for submarine command or assignment goes on shore duty he is not, for the time spent on shore duty, technically assigned to the submarine service. While on shore duty he does not receive his extra submarine pay but he never loses his submarine qualification except for physical disability. Extra pay for the qualified submarine officer on active submarine duty is 25 percent increase of the base salary. The average shore duty is 2 years.

Submarine officers with the rank of captain have little occasion to actually be aboard or ride in a submarine. In very rare cases a captain might ride but not in any repeated routine manner and probably only during fleet exercises. Submarine officers with the rank of commander have little occasion for routine submarine trips but would ride a little more frequently. At present each submarine division has a division commander who may be an officer with the rank of commander. There would not be over seven such officers in the Navy at one time. In 1936 there were only two captains and four commanders assigned to submarine executive duty. Navy doctors assigned to the supervision of submarine personnel usually ride the tender or the salvage ship accompanying the submarines and occasionally make trips on these boats.

A submarine officer of lower rank than the above when on submarine duty is generally stationed aboard the submarine. His assignment to any one submarine generally lasts for 2 years per boat.

The turn-over of officers on any particular submarine is generally about two changes in officer personnel per year.

At the present time the enlisted man qualified for submarine duty receives extra pay of $25 to $30 a month depending on his rating while on such assignment. Men volunteering for this work attend the submarine school at New London for a 6-weeks' period. Some of the higher ratings such as machinist mates may spend as long as 36 weeks there. Then these men are ordered to some submarine and after serving aboard satisfactorily for 6 months are eligible for submarine qualifications after they have passed an examination. I was advised that men came from all branches of the service into this submarine work and that there was no noticeable tendency of a greater proportion of men from the submarine tenders and supply vessels to enter this service than other general officers and men.

The average yearly turn-over of petty officers and other enlisted men on a particular submarine would be over 100 percent, although some men might stay aboard for several years. There would probably be a turn-over of two chief petty officers per year. No warrant officers are ever attached to submarines.

While this paper is not being prepared to cover Navy divers as such, I thought it would be of interest to include at this point some information about Navy divers. In reply to a question as to whether Navy diver applicants were likely to be qualified submarine men, or whether the diver applicants are just as likely to be from the general fleet, I was advised that all divers come from the fleet. I was also informed that the Navy has "30 officers who are on diving duty but who practically never dive; several of these are doctors who may have to take pressure in case of the development of compressed-air disease in one of the divers. Then there are 21 master divers, 91 first-class divers, and 484 second-class divers allowed in the entire Fleet. This quota is approximately filled. This group will dive an average of at least 20 dives a year, including their qualification and requalification dives and their salvage dives. So in all we would average about 12,520 dives per year by the 626 qualified divers and you will see that in the Statistics of Disease and Injuries in the United States Navy for the Calendar Year of 1936 there were listed 15 cases of caisson disease (we prefer to call it compressed-air disease) and 1 death. Now this in itself is not a bad average but if you go into it further you will find that all of this trouble, i. e., the caisson disease and the one death occurred at the experimental diving unit where the work we were doing forced us to carry the experiments to the stage of producing caisson disease in a certain number of the subjects in order to know when the end point in the experiment had been reached. I think you will find that out in the regular diving game in the fleet

there was no trouble whatsoever. Experimental work is always hazardous, as you know, but even there we had but one death in over 6 years of constant daily diving."

Mortality and Morbidity Record

Beginning with the calendar year 1919 and extending through 1936 we were able to obtain a complete record of deaths among submarine officers. These deaths were divided into occupational accidents, nonoccupational accidents and disease, the findings summarized, and a tabulation made in table I. A similar summary was made for the enlisted men over a period 1922–36 in table II.

A morbidity and invaliding record for submarine men over the years 1923–32 was prepared and contrasted with the general Navy average. The details for the respective years follow.

For the calendar year 1922 three occupational deaths were recorded, one accidental death on leave, and two deaths from disease.

In 1923 there were 25 admissions for accidental injuries associated with duty on board submarines. These were all that were reported under the key letter "S," denoting connection with submarine duty. The instructions regarding the use of this letter are that it shall be used for disease as well as injuries incidental to peculiar living conditions aboard the submarine and to actual maneuvering of, or accident to the vessel. There were no admissions for disease reported as dependent upon living or working conditions in submarines.

Of the 25 cases of accidental injuries recorded, 7 cases were fatal. Four of the deaths were caused by drowning, and the other three, resulting from multiple injuries, were all caused by an explosion of hydrogen gas in the after battery compartment of the U. S. S. *S–37*. Three of the men drowned were lost when the U. S. S. *O–5* was rammed and sunk by a merchant vessel in the harbor of Cristobal, Canal Zone. The other man who lost his life by drowning was attached to the U. S. S. *R–23*. He fell overboard while the boat was at sea, striking his back on the hull of the boat. No one attached to the submarines was reported as invalided from the service. In addition there were two accidental drownings on leave and one death from disease.

In 1924 there were 18 admissions for injuries recorded from submarine hazards. One man injured in a battery explosion was subsequently discharged for permanent disability. There were 502 sick days. There were no admissions from disease of any kind incident to the peculiar living conditions aboard submarines. Three occupational deaths were recorded, one caused by bursting of a Diesel engine, one from gasoline explosion, and one drowning. In addition two fatal nonoccupational accidents and three deaths from disease.

In 1925 the *S–51* was rammed by the steamship *City of Rome* off Block Island on the Atlantic seaboard. The history of this disaster and the diving activities connected with the salvage work are described in Commander Ellsberg's book "On the Bottom." Six officers and 27 enlisted men were drowned. Apart from this disaster there was one other occupational death due to a fall. There were 17 admissions from submarine hazards. One man was injured by a fall through a hatch and nine were for injuries caused by submarine engines, other machinery, and batteries. The remaining seven admissions were attributed to hazards more or less peculiar to living or working conditions on submarines. The injuries in these cases were burns, or lesions of minor importance resulting from falls, or stumbling over obstacles on board. One case of heat exhaustion occurred which was the only admission other than for injuries, there being no admission for disease attributable to the working and living conditions of submarines.

There were nine accidental deaths among the men on leave or liberty, one suicide, and one death from disease. One suicide was also recorded among officers.

Injuries of a minor nature were more completely reported during the year 1926 and injuries resulting from falls on board submarines and those caused by like hazards, which might be encountered in any type of vessel, have been charged to submarine hazards, whereas formerly they were in some cases simply recorded as caused by falls.

These changes in practice largely account for the increased number of admissions and sick days in 1926. Of the 59 admissions for this year, only 23 were for injuries occurring while submarines were operating, but in all except 2 of the 59 cases, the injured person was working when the accidents occurred. One enlisted man was invalided from the service because of faulty union of a fracture caused by an explosion of hydrogen gas from storage batteries in the U. S. S. *S–49*. The explosion occurred while the vessel was moored alongside the dock at the submarine base, New London, just as a pilot cell cover was being removed for the purpose of testing the specific gravity of the electrolyte. The battery deck was blown up. Twelve enlisted men were injured. Three died a few hours after the accident from multiple injuries and one man died 4 days later. Two other occupational deaths occurred this year. An enlisted man who was working on the bridge of a submarine anchored at sea outside of San Francisco Bay lost his footing when the vessel took a sudden roll, fell overboard, and was drowned. Another fell overboard from submarine in port and was drowned. Injuries making up the total of 59 admissions were caused by machinery, engines, falls, and other miscellaneous accidents. One case of heat exhaustion was reported. In addition there were two

accidental deaths among the men on leave and two deaths from disease. There were no deaths recorded among officers.

Of the 90 admissions in 1927, 54 were injuries occurring while submarines were operating, and in all except 5 instances the injured persons were working when the accidents occurred. Thirty-eight of the ninety admissions occurred in connection with the sinking of the U. S. S. *S-4*, which resulted through the collision with the United States Coast Guard cutter *Paulding*. The submarine was running submerged during standardization trials in Cape Cod Bay near Provincetown, Mass., at the time. The cause of death was recorded as asphyxiation in the case of 1 officer and 5 enlisted men, and as drowning in the case of the remaining 4 officers and 28 men. One other occupational death reported for the year occurred near Tsingtao, China; an enlisted man lost his balance and fell overboard while lifting a guard rail on a submarine. He could not swim and was drowned. The remaining injuries resulted from operating machinery and engines, falls, heavy seas, striking against objects, and so forth. Another case of heat exhaustion in the engine room was also reported.

Four enlisted men were invalided from the service. A contusion of the leg received while handling lines in mooring a submarine led to invaliding in one case, and injuries received on board a submarine in 1926, during an explosion of hydrogen gas from storage batteries, in three cases. In addition there were six nonoccupational accidental deaths and four deaths from disease.

In 1928, 69 admissions were reported. Twenty-six were for injuries occurring while submarines were operating and in all except one instance the injured persons were working when the accidents occurred. There were 43 admissions for injuries received while submarines were moored. The accidents show the typical miscellaneous distribution of causative agencies, i. e., machinery, engines, falls, etc. There were no deaths and no person invalided from the service on account of injuries due to submarine hazards. There were four accidental deaths on leave and five deaths due to disease.

Of the 73 admissions in 1929, 26 were for injuries occurring while submarines were operating and in all except 2 instances the injured persons were working when the accidents occurred. There were 47 admissions for injuries received while submarines were moored. There were two deaths from drowning caused by falls overboard, one while the submarine was at sea, and the other while moored. At this point I would note that in examining these miscellaneous injuries that only a very small percentage were caused by work around batteries. Practically all of the injuries were sustained through general hazards of operating a boat which could just as well have been experienced on any craft as well as on submarines. In addition three fatal accidents oc-

curred on leave and two deaths from disease among the men. One death from disease was recorded for a submarine officer.

The 57 admissions in 1930 showed 22 occurring while submarines were operating and 35 while moored. There does not seem to be any tendency for more injuries to be sustained while maneuvering the submarine than while moored along the dock. One death occurred from drowning, washed overboard. There are only a few admissions from injuries sustained while handling torpedoes in the record for these years. Apparently no more than might be caused in the ordinary gun drill. No deaths have resulted from torpedo drill or handling in submarines for the years under review. There were also five accidental deaths on leave and seven deaths due to disease, including one from caisson disease. One death from disease was recorded among officers.

1931 had 65 admissions, 20 for injuries while submarines were operating and 45 while moored. There were two deaths from drowning, caused by falls overboard. No invalidings were reported. There were three nonoccupational accidental deaths and one due to traumatic air embolism while using the training "lung."

For 1932 there were 62 admissions, 17 while operating, 45 while moored. One death was caused by electric shock while the submarine was at dock. There were three accidental deaths on leave and one death among officers was of accidental nature while on leave. After 1932 no separate record of admissions and sick days for the submarine service as distinct from the general navy figures is recorded in the Annual Reports of the Surgeon General so it was thought advisable to summarize the data at this point in the following table.

Admissions, sick days, invalided, due to submarine service hazards

Year	Number of officers and men	Admissions	Rate per 1,000	Sick days	Rate per 1,000	Invalided from the service	Rate per 1,000
1923	2,472	25		640		0	
1924	2,925	18		502		1	
1925	3,292	50		290		0	
1926	3,332	59		1,947		1	
1927	3,245	90		1,560		4	
1928	3,447	69		1,419		0	
1929	3,443	73		1,067		0	
1930	3,554	57		908		0	
1931	2,709	65		2,193		2	
1932	2,468	62		790		0	
Average	3,089	57	18	1,132	354	0.8	0.26

We may compare these figures to a general average for the entire Navy, if we take the results for 1933 which are very close to the Navy means for the preceding 5 years.

Year	Number officers and men	Admissions	Rate per 1,000	Sick days	Rate per 1,000	Invalided from the service	Rate per 1,000
1933	108, 183	6, 800	63	15, 661	1. 448	139	1. 28

As presented above the figures exclude homicidal injuries and suicides (both actual and attempted) and poisoning by food. These figures for the Navy should be further adjusted to obtain a picture more nearly similar with that of the submarine service. For this purpose the figures for accidents occurring on "leave or liberty" were deducted from the Navy totals leaving only the exposure occurring "within command" and similarly for sick days and invalidings from service.

Year	Number officers and men	Admissions	Rate per 1,000	Sick days	Rate per 1,000	Invalided from the service	Rate per 1,000
1933	108, 183	4, 671	44	89, 474	820	55	0. 51

This permits a comparison for accidents and accidental poisonings for a 10-year period of submarine service and the same for a 5-year period for the entire Navy. We find that the rate per thousand, for admissions in the submarine service was 18; for the Navy 44. The rate per thousand for sick days in the submarine service was 354, while the Navy figure is 820. Invaliding from the service was 0.26 per thousand, from submarine hazards and 0.51 per thousand for the entire Navy from causes occurring "within command."

These results while by no means conclusive indicate very definitely a favorable comparison for the submarine service as against the figures for entire Navy service. This may be due in some measure to the care exercised in selecting men for the submarines and to the very rigorous application of all safety measures. There is also the probability that these men as a class are more seasoned in safeguarding themselves against the average nautical accident as there is a great preponderance of technical men among them. They are all experts in their particular line as must necessarily be the case for those connected with submarines where carelessness or inexperience could not be tolerated.

Continuing the mortality data we note for 1933 two accidental deaths on leave among enlisted men and one suicide. There were also two nonoccupational accidents for officers and one disease death. In 1934 an enlisted man was killed by an explosion of a signal shell. There were three nonoccupational accidents and three deaths from disease. No deaths among officers. In 1935 one occupational, three nonoccupational, and one suicide among enlisted men. No deaths for officers. For 1936 there was one nonoccupational accident and one

death from disease. Among officers the only death recorded resulted from an airplane accident.

TABLE I.—*Officers—United States Submarine Service*

MORTALITY DATA

Year	Number of officers	Rank	Station or ship	Age at death	Accidental deaths		Disease
					Occupational	Nonoccupational	
1919	245				None	None	None.
1920	266				do	do	Do.
1921	252				do	do	Do.
1922	250				do	do	Do.
1923	272				do	do	Do.
1924	306				do	do	Do.
1925	309	Lt.	S-51	32	Collision—drowned	do	Do.
1925		Ens.	S-51	24	do	do	Do.
1925		Lt., J. G.	S-51	26	do	do	Do.
1925		Lt., J. G.	S-51	28	do	do	Do.
1925		Lt., J. G.	S-51	28	do	do	Do.
1925		Lt., J. G.	S-51	28	do	do	Do.
1925		Lt., J. G.	S-51	27	None	do	Suicide.
1926	314				do	do	None.
1927	321	Lt. Com.	S-4	38	Collision—drowned	do	Do.
1927		Lt., J. G.	S-4	25	do	do	Do.
1927		Lt. Com.	S-4	34	do	do	Do.
1927		Lt., J. G.	S-4	29	do	do	Do.
1927		Lt., J. G.	S-4	26	do	do	Do.
1928	333					do	Do.
1929	370	Lt., J. G.		29	None	do	Osteomylitis.
1930	382	Lt., J. G.		30	do	do	T. B.
1931	325	Lt., J. G.		26	do	do	Septicemia.
1932	313	Lt., J. G.	S-34	28	do	Auto accident—leave	None.
1933	297	Lt., J. G.	S-47	28	do	None	Streptococcus.
1933		Lt., J. G.	New London.	29	do	Auto accident—leave	None.
1933		Lt.	Dolphin	34	do	do	Do.
1934	300				do	None	Do.
1935	302				do	do	Do.
1936	310	Lt., J. G.	S-25	27	Airplane crash	do	Do.

Years	Total exposed	Average age at death	Total occupational	Total nonoccupational	Total disease
18	5,467	29	12	3	5

Over the 18-year period 1919–36, inclusive, we have a total life years of exposure for officers of 5,467. The average age at death was 29. There were 12 occupational deaths, 6 lost on the *S-51* in 1925, 5 lost on the *S-4* in 1927 and 1 death as a result of an airplane crash in 1936. The accidental occupational death rate is 2.2 per thousand. Over this period there were three accidental deaths due to nonoccupational causes, all automobile accidents while on leave. The resulting rate being 0.55 per thousand. The total accidental death rate was 2.75 per thousand. There were five deaths as a result of disease all differing as to cause.

The percentage of active officers in the various ranks was determined to be as follows: Ensigns 3 percent, age group 20–24; lieutenants, junior grade 60 percent, age group 25–29; lieutenants 25 percent, age group 30–34; officers of higher rank 9 percent, average age group 35–39. On this basis and using the J. O. S. Basic Table 1915–26 for compari-

son, the succeeding table was drawn. In each case the fifth year of duration was assumed as representative.

Rank	Age	(1) Exposed to risk	(2) Actual dead	(3) Expected dead	Ratio percent (2)÷3
					Percent
Ensign	20–24	164	1	0.44	224
Lieutenant junior grade	25–29	3,444	15	9.56	157
Lieutenant	30–34	1,367	2	4.38	45
Lieutenant commander	35–39	492	2	2.02	100
Commander					
		5,467	20	16.40	122±18

If the basic table 1920–34 had been used, the mortality ratio would have been 129 percent±19.

TABLE II.—*Enlisted men, United States Submarine Service*

MORTALITY DATA

Year	Rate	Ship	Age at death	Accidental deaths		Disease
				Occupational	Nonoccupational	
1922	Chief machinist's mate, C. P. O.	L-9	31			Influenza.
1922	Chief torpedoman, C. P. O.	R-10	39			Myocarditis.
1922	Engineer, 2d class	L-6	25	Drowned—washed overboard at sea		
1922	Radioman, 3d class	O-15	19	Drowned—fell overboard at sea		
1922	Chief electrician mate, C. P. O.	O-14	27	Drowned—washed overboard at sea		
1922	Torpedoman, 1st class, P. O.	S-51	27		Roller coaster	
1923	Mess attendant	S-37	24	Battery explosion		
1923	Machinist mate, P. O.	O-13	25			Atrophy of liver.
1923	Torpedoman, 1st class, P. O.	R-23	25	Drowning—fell overboard		
1923	Machinist mate, P. O.	S-37	36	Battery explosion		
1923	Torpedoman, 3d class	O-11	27		Drowning	
1923	Electrician mate, P. O.	S-37	23	Battery explosion		
1923	Machinist mate, P. O.	O-5	24	Collision—thrown off ship and drowned		
1923	Fireman, 1st class	O-5	23	do		
1923	Mess attendant	O-5	37	do		
1923	Boatswain mate, 2d, P. O.	T-2	27		Drowning	
1924	Chief machinist mate, C. P. O.	S-2	30	Diesel valve—blow out		
1924	Torpedoman, 1st class, P. O.	S-40	31			Suicide.
1924	Torpedoman, 3d class	O-12	24	Can gasoline explosion		
1924	Ships cook, 1st class, P. O.	O-3	34			Malaria.
1924	Torpedoman, 2d class	N-1	24		Auto accident	
1924	Machinist mate, P. O.		32			Duodenal ulcer.
1924	do	S-40	27		Drowned	
1924	Engineer, 2d class	S-11	27	Drowned—fell overboard at work		
1925	do	S-51	21	Collision—drowned		
1925	Gunners mate, P. O.	S-51	25	do		
1925	Radioman, 1st class, P. O.	S-51	24	do		
1925	Engineer, 1st class, P. O.	S-51	25	do		
1925	Coxswain, P. O.	S-51	26	do		
1925	Machinist mate, P. O.	S-51	28	do		
1925	Engineer, 2d class, P. O.	S-51	25	do		
1925	Chief torpedoman, C. P. O.	S-51	35	do		
1925	Chief machinist mate, C. P. O.	S-51	35	do		
1925	Electricians mate, P. O.	S-51	27	do		
1925	Engineer, 2d class, P. O.	S-51	24	do		
1925	Seaman, 1st class, P. O.	S-51	21	do		
1925	Chief electrician mate, C. P. O.	S-51	41	do		
1925	Fireman, 2d class	S-51	18	do		
1925	Fireman, 1st class, P. O.	S-51	21	do		
1925	Machinist mate, P. O.	S-51	27	do		
1925	Radioman, 1st class, P. O.	S-51	22	do		

TABLE II.—*Enlisted men, United States Submarine Service*—Continued

MORTALITY DATA

Year	Rate	Ship	Age at death	Accidental deaths		Disease
				Occupational	Nonoccupational	
1925	Electrician mate, P. O	S-51	24	Collision—drowned		
1925	Machinist mate, P. O	S-51	25	do		
1925	Torpedoman, 2d class, P. O	S-51	27	do		
1925	Chief signalman, C. P. O	S-51	34	do		
1925	Seaman, 1st class, P. O	S-51	19	do		
1925	do	S-51	19	do		
1925	Fireman, 2d class	S-51	21	do		
1925	Torpedoman, 3d class, P. O	S-51	24	do		
1925	Torpedoman, 1st class, P. O	S-51	28	do		
1925	Torpedoman, 3d class, P. O	S-51	26	do		
1925	Seaman, 1st class	S-4	22		Auto accident	
1925	Torpedoman, 1st class, P. O	S-11	24		Drowned	
1925	Machinist mate, P. O	S-29	35		Auto accident	
1925	Ships cook, 1st class, P. O	S-17	27		do	
1925	Seaman, 1st class	S-38	20			Suicide.
1925	Water tender, 1st class, P. O	R-15	29		Drowned	
1925	Electrician mate, P. O	S-40	20			Appendicitis.
1925	Boatswain mate, P. O	S-15	24	Fell from submarine, struck head		
1925	Seaman, 2d class	S-14	20		Drowned	
1925	Torpedoman, 2d class, P. O	S-45	28		Train accident	
1925	Chief machinist mate, C. P. O	R-7	33		Shot, accident	
1925	Ships cook, 2d class, P. O	V-1	24		Motorcycle accident	
1926	Fireman, 1st class	S-14	27		Train accident	
1926	Radioman, 3d class, P. O	R-5	21		Auto accident	
1926	Seaman, 1st class	S-49	22	Battery explosion		
1926	Electrician mate, P. O	S-49	34	do		
1926	Chief boatswain mate, C. P. O	S-49	23	do		
1926	Chief machinist mate, C. P. O	N-1	37		Hit by person	
1926	Seaman, 2d class	R-11	21			Encephalitis.
1926	Torpedoman, 2d class, P. O	S-24	27	Drowned—fell overboard at sea		
1926	Engineer, 2d class, P. O	S-34	33			Heart disease.
1926	Gunners mate, P. O	S-49	27	Battery explosion		
1926	Engineer, 2d class, P. O	S-49	24		Drowned	
1926	Coxswain, P. O	S-10	24	Drowned—fell overboard from submarine in port.		
1926	Fireman, 3d class	O-10	26			Cirrhosis of liver.
1926	Electrician mate, P. O	R-12	23			Suicide.
1926	Engineer, 1st class, P. O	S-16	31			T. B.—other than lung.
1926	Seaman, 1st class	O-9	23			Tonsillectomy.
1926	Engineer, 1st class, P. O	S-8	27		Auto accident on leave	
1927	Engineer, 1st class, P. O	S-4	28	Collision—drowned		

1927	Radioman, 1st class, P. O	S-4	25	do		
1927	Chief electrician mate, C. P. O	S-4	35	do		
1927	Fireman, 3d class	S-4	21	do		
1927	Seaman, 2d class	S-4	20	do		
1927	Machinist mate, P. O	S-4	26	do		
1927	Chief radioman, C. P. O	S-4	37	do		
1927	Torpedoman, 1st class, P. O	S-4	26	do		
1927	Machinist mate, P. O	S-4	28	do		
1927	Signalman, 1st class, P. O	S-4	28	do		
1927	Machinist mate, P. O	S-4	24	do		
1927	Fireman, 3d class	S-4	19	do		
1927	Electrician mate, P. O	S-4	24	do		
1927	Machinist mate, P. O	S-4	34	do		
1927	Ships cook, 2d class, P. O	S-4	25	do		
1927	Seaman, 2d class	S-4	21	do		
1927	Chief machinist mate, C. P. O	S-4	41	do		
1927	Machinist mate, P. O	S-4	29	do		
1927	Electrician mate, P. O	S-4	28	do		
1927	Fireman, 3d class	S-4	19	do		
1927	Engineer, 2d class, P. O	S-4	28	do		
1927	Seaman, 2d class	S-4	21	do		
1927	Coxswain, P. O	S-4	25	do		
1927	Electrician mate, P. O	S-4	23	do		
1927	Quartermaster, 3d class, P. O	S-4	22	do		
1927	Torpedoman, 1st class, P. O	S-4	34	do		
1927	Engineer, 2d class, P. O	S-4	26	do		
1927	Seaman, 1st class	S-4	22	do		
1927	do	S-4	22	do		
1927	Mess attendant	S-4	26	do		
1927	Engineer, 2d class, P. O	S-4	26	do		
1927	Seaman, 1st class	S-4	24	do		
1927	Fireman, 1st class	S-4	24	do		
1927	Seaman, 1st class	S-44	20			Leukemia.
1927	Boatswain mate, P. O	S-47	25		Shot—accident	
1927	Machinist mate, P. O	S-49	40			Understandard.
1927	do	S-41	28		Auto accident	
1927	Chief electrician mate, C. P. O	S-33	25			Malaria.
1927	Machinist mate, P. O	S-17	28			T. B.
1927	Fireman, 2d class	S-31	21	Drowned—fell from submarine at sea		
1927	Engineer, 1st class, P. O	S-15	27		Auto accident	
1927	Engineer, 2d class, P. O	S-9	26		Gas—accident	
1927	Signalman, 2d class, P. O	S-47	25		Motorcycle accident	
1927	Engineer, 2d class, P. O	S-41	25		Auto accident	
1928	Seaman, 1st class	S-19	20		Motorcycle accident	
1928	Yeoman, 1st class, P. O	S-44	26			Pneumonia.
1928	Torpedoman, 1st class, P. O	S-9	28		Auto accident	
1928	Chief boatswain mate, C. P. O	S-18	30		do	
1928	Engineer, 2d class, P. O	S-47	23			Meningitis.
1928	Storekeeper, 2d class, P. O	S-32	30			Suicide.
1928	Fireman, 2d class	S-3	24		Motorcycle accident	
1928	Fireman, 1st class	S-17	26			Tonsillar abscess.
1928	Machinist mate, P. O	R-17	25			T. B.
1929	Electrician mate, P. O	V-4	25		Motorcycle accident	

TABLE II.—*Enlisted men, United States Submarine Service*—Continued

MORTALITY DATA

Year	Rate	Ship	Age at death	Accidental deaths		Disease
				Occupational	Nonoccupational	
1929	Seaman, 1st class	O-2	24	Drowned—fell off submarine		
1929	Engineer, 2d class, P. O	S-22	22		Auto accident	
1929	Machinist mate, P. O	S-38	22			T. B.
1929	Chief electrician mate, C. P. O	S-39	39			Liver abscess.
1929	Torpedoman, 1st class, P. O	S-45	31		Auto accident	
1929	Chief machinist mate, C. P. O	R-11	32	Drowned—fell from submarine at dock		
1930	Quartermaster, 1st class, P. O	R-7	24			"Caisson" disease.
1930	Radioman, 2d class, P. O	R-5	24	Drowned—fell from submarine at sea		
1930	do	V-1	22		Motorcycle accident	
1930	Fireman, 2d class	O-1	19		Auto accident	
1930	Quartermaster, 2d class, P. O	S-41	29			Cirrhosis of liver.
1930	Radioman, 3d class, P. O	S-38	22			Encephalitis lethargic.
1930	Engineer, 2d class, P. O	O-9	32		Auto accident	
1930	Gunners mate, 1st class, P. O	V-4	28			Pneumonia.
1930	Torpedoman, 2d class, P. O	R-17	29			Duodenal ulcer.
1930	Electrician mate, 1st class, P. O	V-2	29		Shot—accident	
1930	Radioman, 2d class, P. O	S-35	27			Appendectomy.
1930	Torpedoman, 2d class, P. O	V-5	24			Do.
1930	Machinist mate, 1st class, P. O	S-44	31		Motorcycle accident	
1931	Mess attendant, 1st class	R-14	38		Train accident	
1931	Fireman, 1st class	O-1	24		Motorcycle accident	
1931	Ship's cook, 3d class	S-38	22	Drowned—fell from submarine in port		
1931	Fireman, 2d class	Nautilus	24	do		
1931	Boatswain mate, 1st class, P. O	do	33			"Caisson" disease.
1931	Seaman, 1st class	Barracuda	20		Motorcycle	
1932	do	Bonita	26		Auto accident	
1932	Quartermaster, 2d class, P. O	S-18	33		Stove explosion	
1932	Fireman, 3d class	S-12	20	Electric shock work on submarine in port		
1932	Coxswain, P. O	Barracuda	34			T. B.
1932	Electrician mate, 1st class, P. O	S-18	31		Drowned	
1933	Torpedoman, 2d class, P. O	S-36	30			Suicide.
1933	Gunners mate, 2d class, P. O	S-10	33		Drowned	
1933	Machinist mate, 2d class, P. O	Norwhal	24		Auto accident	
1934	Electrician mate, 1st class, P. O	S-25	34		Shot	
1934	Machinist mate, 2d class, P. O	S-33	29		Auto accident	
1934	Machinist mate, 1st class, P. O	S-22	33			Pneumonia.
1934	do	S-47	32			Glioma (brain).
1934	Coxswain, P. O	Barracuda	25		Auto accident	
1934	Machinist mate, 1st class, P. O	Argonaut	34			T. B.
1934	Gunners mate, 2d class, P. O	S-34		Signal shell explosion		
1935	Fireman, 2d class	S-41	26			Suicide.

1935	Seaman, 1st class	Bonita	22	Fall at drydock		
1935	Ship's cook, 3d class	S-11	26		Drowned	
1935	Radioman, 3d class, P. O.	Nautilus	22		Auto accident	
1935	Machinist mate, 2d class, P. O.	Dolphin	25		Motorcycle	
1936	Seaman, 1st class	Nautilus	25		Drowned	
1936	Chief machinist mate, C. P. O.		43			Psychosis—exhaustive.

Grand total exposed	Grand total occupational	Grand total nonoccupational	Grand total disease
39,061	89	52	40

Enlisted men—United States Submarine Service

MORTALITY DATA

Year	Total exposed	Chief petty officers			Petty officers			Other enlisted men		
		Occupational accidents	Nonoccupational accidents	Disease	Occupational accidents	Nonoccupational accidents	Disease	Occupational accidents	Nonoccupational accidents	Disease
1922	2,554	1	None	2	2	1	None	None	None	None
1923	2,200	None	None	None	4	2	1	3	None	None
1924	2,619	1	None	None	2	2	3	None	None	None
1925	2,982	4	1	None	21	6	1	3	2	1
1926	3,018	1	1	None	4	3	3	1	1	3
1927	2,924	3	None	1	19	6	2	12	None	1
1928	3,114	None	1	None	None	1	4	None	2	1
1929	3,073	1	None	1	None	3	1	1	None	None
1930	3,172	None	None	None	1	4	7	None	1	None
1931	2,384	None	None	None	None	None	1	2	3	None
1932	2,155	None	None	None	None	2	1	1	1	None
1933	2,115	None	None	None	None	2	1	None	None	None
1934	2,200	None	None	None	1	3	3	None	None	None
1935	2,250	None	None	None	None	2	None	1	1	1
1936	2,300	None	None	1	None	None	None	None	1	None
Total	39,061	11	3	5	54	37	28	24	12	7

The total life years of exposure for enlisted men was 39,061 over the period 1922–36. There were 89 accidental deaths due to occupational hazards. Nonoccupational deaths of accidental nature while on "leave or liberty" totaled 52. There were 40 deaths due to disease, among which only 2 may be directly ascribed to occupational conditions. These two deaths occurred during training with the submarine "lung" and have already been considered. In this service approximately 10 percent of the enlisted personnel are chief petty officers of age group 35–39. These are the highest ranking enlisted men in submarine work, there being no warrant officers assigned to this branch. Among this group of chief petty officers there were 11 occupational accidental deaths, 3 nonoccupational, and 5 deaths due to disease. The percentage of petty officers is very high in submarine service, approximately 65 percent of the enlisted personnel having a petty officer's rank. Among this group there were 54 occupational accidental deaths, 37 nonoccupational accidents, and 28 deaths due to disease, the age group being 25–29. Other enlisted men, such as seamen, firemen, mess attendants, and cooks third class, represent 25 percent of the service enlisted personnel. Among this group with ages 20–24 there were 24 occupational accidents, 12 nonoccupational, and 7 deaths from disease. The above figures are summarized in the following table with the J. O. S. 1915–26 basic table for approximate comparison.

Rate	Age group	(1) Exposed to risk	(2) Actual dead	(3) Expected dead	Ratio, percent, 2÷3
Chief petty officers	35–39	3,906	19	16.2	117
Petty officers	25–29	25,390	119	70.5	169
Other enlisted men	20–24	9,765	43	25.9	166
Total		39,061	181	112.6	159

The chief petty officers evidence a ratio of 117 percent. The five deaths due to disease were from varied causes.

The occupational accident rate was 2.81 per 1,000, the nonoccupational accidental death rate 0.77. The total accident rate 3.58 per 1,000.

Among petty officers the ratio is 169 percent, 45 percent of the deaths being caused by accidents from occupational hazards, with a rate of 2.12 per 1,000. Nonoccupational accidents caused 31 percent of the deaths, with a rate of 1.46 per 1,000. As a matter of coincidence the total accidental death rate is 3.58 per 1,000, the same as for chief petty officers. Deaths due to disease are low in this petty officer group, comprising only 24 percent of the total deaths. The higher death ratio being practically entirely due to accident. Of the 28 deaths resulting from disease there were 5 due to tuberculosis of the lungs and 1 case of tuberculosis other than pulmonary. The pulmonary tuberculosis rate is well under normal, being 0.20 per 1,000. Exposure deaths, such as pneumonia and influenza, were low and the other disease deaths were evenly distributed over a variety of miscellaneous causes.

Other enlisted men had an occupational death rate of 2.46 per 1,000 and a nonoccupational rate of 1.23, comprising a total rate of 3.69 per 1,000. On the basis of the J. O. S. there were expected 19.5 deaths from disease, whereas the actual was 7, indicating the higher death rate to be due to accident.

Seventy-five percent of the fatal occupational accidents among officers and men occurred as the result of collisions. There were seven deaths due to the explosion of hydrogen gas from the batteries. This hazard has apparently been minimized by safety precautions and is probably no greater than explosions from various agencies on other war vessels.

For the purpose of comparing the accidental death rate for officers and men of the submarine service with that of the entire Navy the following material is added.

ACCIDENTAL DEATH RATE

Commissioned Personnel entire Navy

Year	Exposed	Deaths			Rate per 1,000		
		(1)	(2)	(3)	(1)	(2)	(3)
1923	7,704	16	5				
1924	8,058	28	12				
1925	8,210	29	7				
1926	8,639	21	8				
1927	8,742	29	5				
1928	8,793	34	9				
1929	8,925	19	9				
1930	9,013	22	3				
1931	9,184	14	8				
1932	9,503	14	7				
1933	9,456	41	7				
				+9			
Total	96,227	267	80	89	2.8	0.83	0.93

This table of officers excludes those of the Marine Corps, midshipmen, and cadets, but includes warrant officers. Column (1) under deaths includes all casualties from injury, poisoning, suicide, and homicide. Here the result is 267 deaths with rate per 1,000 of 2.8. Under column (2) deaths from aviation, both lighter and heavier than air, suicide, and submarine activity, are excluded. This naturally brings the rate down substantially and we have 80 deaths with the rate of 0.83 per 1,000. The final figure for comparison purposes is under column (3); here the figure in column (2) has been adjusted to include 25 percent of the suicides. This final figure under column (3) indicates a fatal accident rate among Navy officers of 0.93 per 1,000, as against 2.75 for submarine officers. For the purpose of record I have listed hereunder the deaths from aviation and suicide used in obtaining this final figure.

Suicides entire Navy and Deaths due to Navy Aviation

Year	Aviation deaths		Suicide		Year	Aviation deaths		Suicide	
	Officers	Men	Officers	Men		Officers	Men	Officers	Men
1923	8	7	3	18	1929	8	6	2	13
1924	14	12	2	22	1930	13	5	6	13
1925	11	14	4	13	1931	4	9	2	12
1926	13	2	0	11	1932	4	11	3	13
1927	17	12	2	21	1933	26	66	8	20
1928	20	6	5	13					

Similarly for enlisted men the following table is added:

Enlisted Personnel entire Navy

Year	Exposed	Deaths			Rate per 1,000		
		(1)	(2)	(3)	(1)	(2)	(3)
1923	85, 217	194	162				
1924	87, 442	215	180				
1925	84, 467	161	107				
1926	83, 461	122	104				
1927	84, 672	177	109				
1928	84, 940	138	119				
1929	85, 999	127	107				
1930	85, 813	138	119				
1931	81, 274	161	138				
1932	81, 534	135	110				
1933	79, 726	199	112	+42			
Total	924, 545	1, 767	1, 367	1, 409	1. 9	1. 48	1. 53

The fatal accident rate here is 1.53 for enlisted men in the Navy as compared with an average of 3.60 for enlisted men in submarine service. The difference is a little less than 2 extra deaths per 1,000. The mortality other than from accident appears to be low for both officers and men in the submarine service.

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OBSERVATIONS ON STAPHYLOCOCCUS FOOD POISONING

REPORT OF AN OUTBREAK

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A number of cases of acute gastroenteritis which occurred during the years 1909–13 on a certain farm in Nueva Ecija Province, Luzon, P. I., were investigated by Barber (*1*) and were reported by him in 1914. His investigations revealed that only occasional attacks occurred in American residents and Filipino employees of the farm, but more often visitors were attacked. It was observed that cream from the milk of one particular cow had been ingested in each instance before the attack, the attacks were limited to warm summer months, and no re-

frigerating facilities were in use on the farm. Bacteriological anaylsis of samples of fresh milk revealed numerous colonies of both staphylococcus albus and aureus. Transfers were made from pure cultures of each organism into milk, incubated at 36.5° C. for 8½ hours, and a 50-cubic centimeter dose of the inoculated milk was ingested by Barber himself on successive days. In 1¾ hours after ingestion of the milk inoculated with the yellow variety of staphylococcus, an acute gastroenteritis appeared, with violent symptoms lasting between 7 and 8 hours.

Subsequent to the report of Barber, little mention of the staphylococcus as a cause of food poisoning appeared in the literature until 1930. Following this date numerous outbreaks have been observed, a number of which have been reported and are hereinafter listed:

Author	Food	Year
Dack et al. (*2*)	Sponge cake	1930
Jordan (*3*)	Cheese	1930
Ramsey and Tracy (*4*)	Milk	1931
Jordan and Hall (*5*)	Chicken gravy	1931
Jordan (*6*)	Cake	1931
Tanner and Ramsey (*7*)	Milk	1932
McBurney (*8*)	Chocolate eclairs	1933
Jordan and Burrows (*9*)	Custard-filled bakery goods, bakery goods, custard-filled coffee cakes, doughnuts, chocolate eclairs (5 outbreaks).	1934
Crabtree and Litterer (*10*)	Milk	1934
Corpening and Foxhall (*11*)	Custard-filled cake	1935
Geiger et al. (*12*)	Ice cream	1935
Dack et al. (*13*)	Tongue sandwiches	1935
Denison (*14*)	Cream puffs	1936
Shaughnessy and Grubb (*15*)	Milk	1936
Geiger (*16*)	Custard cake	1937

An outbreak of food poisoning involving over 250 men at the marine base, Quantico, Va., was mentioned in the section on preventative medicine in a recent issue of this publication (*17*). The first symptom in the majority of cases occurred 4 hours after eating the suspected food, which in this case was ham that had been cooked the night before, and had been left overnight in the container to gradually cool. A staphylococcus albus was isolated from a whole ham. A report of an additional outbreak of staphylococcus food poisining due to ingestion of cold boiled ham which was contaminated with a hemolytic staphylococcus aureus, involving 124 men aboard the U. S. S. *Arizona* on December 12, 1936, will be included in this article.

Of particular significance is the constant observation that in the outbreaks of staphylococcus food poisoning that have been reported in the literature, the infected food was unchanged in appearance, odor, and flavor. In their work in experimental staphylococcus food poisoning, Kelly and Dack (*18*) found that there was no change in the taste, appearance, or odor of meat and bread inoculated with staphylococci and incubated for 5 hours at 37° C., confirming an observation of numerous investigators of actual outbreaks of this condition.

Clinical Picture of Staphylococcus Food Poisoning With Important Differential Points

There are two important differences between the staphylococcus type of food poisoning and the more familiar type due to the salmonella group. First, from a clinical standpoint, the incubation period in staphylococcus food poisoning is commonly between 2 and 4 hours, while in salmonella food poisoning the onset of symptoms average between 6 and 12 hours after ingestion of the infected food. In many cases of the salmonella type the incubation period is more than 24 hours. The second, and perhaps most important difference between the staphylococcus and salmonella types of food poisoning is that staphylococci isolated from the former type have certain cultural characteristics which will be described subsequently, and from which a sterile broth filtrate may be obtained which, when swallowed in small amounts by human volunteers, reproduces the symptoms of an acute gastroenteritis. Large amounts of bacteria-free filtrate from salmonella cultures have been fed to humans without producing any symptoms (*19*).

The history, subjective symptoms, and objective signs in an attack of food poisoning due to a staphylococcus are quite uniform, and except for the uniformly short incubation period do not differ in any large measure from attacks due to other organisms. The onset is characterized by severe nausea and abdominal cramps, followed by vomiting and diarrhea. The patient may vomit from a few to 20 or more times during a period of a few minutes to 8 or more hours. At times the vomitus may be streaked with blood. During the vomiting stage, frequent watery stools are passed. The appearance of blood in the stool is common. Early there is normal or subnormal temperature with cold sweating and marked prostration. Severe cases may show an elevation of temperature up to 100° F. on the second day. Occasionally severe cases will suffer with cramps in the flexor muscles of the legs. The acute symptoms generally last from 1 to 8 hours, although some weakness may be present for 1 or more days. Prompt recovery is the rule, no fatal cases having been reported. The treatment is symptomatic.

Experimental and Laboratory Viewpoint of Staphylococcus Food Poisoning

Live cultures of staphylococci which were isolated from milk were swallowed by Barber (*1*) with reproduction of the symptoms of acute gastroenteritis. It was not until 1930 when Jordan (*3*) fed human volunteers bacteria-free filtrates from cultures of staphylococci isolated from a sponge cake which caused an outbreak of gastroenteritis reported by Dack et al. (*2*), with duplication of the characteristic clinical picture.

For many years there has been a degree of uncertainty regarding the unicity or multiplicity of the toxic factor in staphylococcus filtrates. It is now believed that the hemolytic, dermonecrotic, and lethal components are the attributes of a single factor. Dolman (*20*) studied bacteria-free filtrates from 200 different strains of staphylococci. In each instance the filtrate obtained was found to possess a staphylococcus exotoxin of specific pathogenic and antigenic properties. Forty-two human volunteers drank bacteria-free staphylococcus filtrates on 110 occasions with relative impunity. It was found that only occasional strains were capable of producing a filtrate containing a factor that produced gastroenteritis in human volunteers, suggesting thereby that the "enterotoxic" factor is distinct from the hemolytic, dermonecrotic, and lethal components, and is characteristic of only certain strains of staphylococci.

Jordan (*6*) reports that he observed a strain of staphylococcus that retained the ability to produce an enterotoxic factor for as long as 1 year. Other investigators have found that the ability to produce this enterotoxic factor may be lost after repeated transplantation of certain strains. Jordan and Burrows (*21*) found that by the use of starch or custard media, it was possible to produce bacteria-free filtrates containing enterotoxic substances from certain strains which had not yielded enterotoxic filtrates in previous laboratory tests. In addition, strains that apparently had lost the power to produce enterotoxic filtrates through successive transfer, although originally positive, were found to regain that characteristic when transferred to custard medium or to ordinary medium to which starch had been added.

Whereas negative results were obtained by Woolpert and Dack (*22*) in Macacus rhesus monkey feeding experiments using staphylococcic filtrates which were definitely toxic to humans, positive results were obtained when a filtrate was prepared from organisms cultured in an atmosphere of 20–25 percent carbon dioxide.

One of the most important experimental observations on the toxic effects of staphylococcus filtrates was reported by Borthwick (*23*) in 1933. Using rabbits and guinea pigs, he obtained uniformly negative results in feeding experiments except when the hydrogen ion concentration of the stomach was previously adjusted to pH 7.3. Positive results were obtained with intrarectal injection of toxin, only when the rectum had been irrigated with saline and the reaction adjusted to pH 7.3. He also found that staphylococcus toxin when added to gastric juice in vitro, a slightly acid (pH 6.8) or a slightly alkaline (pH 7.8) reaction impaired its activity, while there was no attenuation when the reaction of the juices was pH 7.3. This work suggests one of the possible causes of the infrequency of this type of gastroenteritis in humans, and the frequent failures in human and animal feeding tests.

Dack et al (*2*) report that the viability of staphylococci is destroyed by exposure to 80° C. for 15 minutes, while the potency of the toxic factor is slightly attenuated but not eliminated in filtrates subjected to 100° C. for 30 minutes, as tested by subsequent intravenous injections in rabbits. Jordan's work (*3*) indicated that staphylococcus toxin is destroyed by boiling, although he further reports (*6*) that sterile toxic filtrates retain their original strength when stored at low temperatures for 3 to 4 weeks, and that the toxic qualities are not altered by strong chlorine solutions.

Jordan and Burrows (*21*) and Stritar and Jordan (*24*) conclude in their reports published in 1934 and 1935, respectively, that the ability to produce an enterotoxic substance is not limited to any particular kind of staphylococcus, and that food poisoning strains possess neither biochemical, hemolytic, or agglutinative characteristics to indicate any degree of homogeneity.

A brief report of what is believed to be the first practical cultural method of differentiating enterotoxic and nonenterotoxic strains of staphylococci, which was developed by Stone (*25*), appeared in 1935.

It had been known for some time that upon a combined agar and gelatin medium there could be demonstrated zones of altered gelatin around the colonies subsequent to incubation. Stone and others found that the characteristic liquefication was variable when occurring in the usual beef and veal infusion, or 0.3 percent beef extract, but was specific when beef extract alone was included in a high concentration with the gelatin. With a combination of 3 percent beef extract, 3 percent gelatin, and 1.5 percent agar, he found an improved method using ammonium sulphate solution as a developer, for the demonstration of this characteristic principle. This work has not been published, but the results of his studies are incorporated in the new Difco medium, Bacto-Stone's gelatin agar. Detailed method of preparing this medium and developer, with interpretation of reactions is quoted (*26*):

1. *Procedure.*—(*a*) The medium is prepared for use by slowly adding 7.5 grams of Bacto-Stone's extract gelatin agar to 100 cc of distilled water in an Erlenmeyer flask. The flask should be rotated gently to assure a thorough wetting of the powder and to avoid the formation of lumps.[1]

Sterilize in the autoclave for 20 minutes at 15 pounds pressure (250° F.). If larger individual units are prepared it is recommended that the medium be heated to the boiling point immediately before autoclaving.

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[1] If basic ingredients are used in preparing this medium, the following procedure is recommended by Stone in a personal communication to the author:

1. 3 percent Difco (Bacto) beef extract (other beef extracts have not been compared with the Difco product by Stone).
2. 3 percent Difco granular gelatin.
3. 1½ percent granular agar.
4. Dissolve ingredients in boiling distilled water. Sterilize in autoclave for 20 minutes at 15 pounds pressure. Do not adjust for pH. Do not include other ingredients unless salt and blood are used for a blood agar base.

(*b*) Plates can be poured for streaking suspected foods on in the study of pure cultures. Care should be taken to pour the medium at a temperature (45–50° C.) at which it will flow but at which excessive water of condensation is avoided. The use of porcelain tops on petri dishes is recommended. When time permits, such plates for streaking can be kept for a day or more in the refrigerator before using, in order to secure a dry surface, discouraging the development of spreaders. Plates should be streaked so that in some portion of the plate well-developed isolated colonies will appear.

(*c*) Incubate plates for 24 hours at 37.5° C. Pigmentation is quite vivid on this medium. After incubation the developer is poured gently upon the surface of the medium so that all colonies are completely covered. Let plate stand until the reaction is well defined. Typical reactions are complete, as a rule, in less than 5 minutes.

2. *Preparation of developer.*—(*a*) Place 1 pound of C. P. ammonium sulphate in a 1,000 cc graduate. Add distilled water at 70° C. to bring the volume to 1,000 cc. Stir with glass rod until solution is complete. This developer should be stored in glass-stoppered bottles. Vaseline on the stoppers prevents freezing of the stopper within the bottle neck.

3. *Reaction.*—(*a*) After developing not over 5 minutes, the background of the medium assumes an opaque, yellowish color. Colonies producing "gastro-enterotoxic substance" are surrounded by a clear zone of transparent medium which approximates a radius at least one-eighth inch from the edge of the colony. Experience to date indicates that zoning of a lesser degree is significant, but not necessarily definitely positive. The large definite clear zone parallels active liquefication of Stone's original beef extract gelatin medium, and the weaker zoning colonies parallel slow liquefications or slight liquefications in the same medium.

(*b*) Since the ammonium sulphate does not destroy the viability of the organisms, zones colonies can be picked direct and planted onto two new culture plates. Such spot colony planting can be observed by developing one culture and using the undeveloped correlated culture plate for pure culture study later. Contamination of one colony by rinsing organisms from adjacent colonies does not seem to be a serious hazard to pure colony isolation. Care should be exercised to avoid too active stirring when introducing the platinum loop during colony picking.

(*c*) *B. subtilis*, yeast, and possibly other organisms, give active zoning. Gram staining of the suspected staphylococci colonies is therefore essential as a primary step in working with all unknowns.

4. *Feeding experiments.*—(*a*) The beef extract gelatin agar does not represent a better "toxin" producing medium. It simply provides a practical, and so far specific cultural reaction for typing. For animal feeding tests, starch medium is generally considered superior to other methods.

(*b*) In checking zone reactivity against animal or human feeding tests, comparison should be conducted concurrently rather than some weeks apart. Old cultures occasionally lose both their animal and cultural reactions, and if a feeding test positive strain some time later is checked for zone reactivity, a failure in such a zone behavior should be substantiated with another feeding test.

5. *Reactions on blood agar.*—(*a*) The addition of 0.9 gram of sodium chloride per 100 cc of medium provides an excellent base for uncooked blood agar. Degrees of hemolysis are first noted, then the plate is developed with ammonium sulphate. This method must be used with caution until the combination of reactions that can occur is fully understood. In the study of staphylococci suspected of producing "gastro-enterotoxic substance" one may note the following reactions:

(1) No hemolysis, no zoning. (Considered "potentially nontoxic.")

(2) No hemolysis, moderate to active zoning. (Considered "potentially toxic.")
(3) Hemolysis, no zoning. (Considered "potentially nontoxic.")
(4) Hemolysis, moderate to active zoning. (Considered "potentially toxic.")

Source of Staphylococcus Contamination in Food Poisoning

It has been shown that milk obtained from the udders of apparently healthy cows contains varying numbers of organisms, including various strains of the staphylococcus. A number of outbreaks have been investigated wherein the suspected food was found to have been prepared under generally insanitary conditions, including improperly cleaned equipment, nearby insanitary toilets, excessive handling of the food, numerous flies, and other factors. While human carriers of staphylococci are legion, no attack of this type of food poisoning has been traced to such potential foci of infection as chronic purulent otitis media, chronic tonsillitis, chronic pulmonary disease, osteomyelitis, furunculosis, or other suppurative processes. Contamination of food, other than milk, presumably takes place during manufacturing and cooking processes. It appears that the common modes of contamination include respiratory droplet infection, handling of food and equipment with contaminated hands, use of previously infected materials, improperly cleansed and sterilized equipment, and transfer of organisms by flies and other insects.

Prevention of Staphylococcus Food Poisoning in the Navy

Adequate supervision of the handling, storage, preparation, and consumption of all foods will reduce the incidence of all types of food poisoning. The absence of flies, roaches, and vermin in commissary spaces is of great importance. Personnel involved in the preparation and serving of food should be educated on this subject with special reference to personal cleanliness and hygiene, the avoidance of handling food with their hands, proper refrigeration of all foodstuffs, the necessity of thorough and recent cooking, and the importance of promptly reporting all personal illness including skin diseases to the medical officer.

In the Naval Establishment, particularly in the general messes of ships afloat, outbreaks of food poisoning have occurred at various times. In such outbreaks there has been noted a fairly uniform and characteristic history and sequence of events. The most common story is that of the preparation of various articles of meat, meat products, gravies, custards, and various other items with a high protein content, from 6 to 24 or more hours before consumption, with excessive handling and slow cooling at room temperature in the galley, and neglected refrigeration before being served. The noon meal on Saturday aboard numerous ships will be found to consist of cold boiled ham with vegetable salads or perhaps boiled vegetables. In some instances

the ship's cook is allowed to boil the hams for Saturday dinner during the Friday morning watch. Such a practice doubtlessly has a tendency to make the galley appear more orderly during the regular Saturday morning inspection, but also provides the basis for not infrequent outbreaks of acute gastroenteritis due to the various food poisoning organisms. This is particularly true when the meat is allowed to cool slowly, then handled in the process of removing the bone, and subsequently allowed to remain in a warm atmosphere until served 20 or more hours later. If boiled ham is to be served, it should first be boned, and then placed in the boiler for cooking at such a time that it may be served hot, immediately after having been cooked. If it is desired to serve it cold, the hams should be transferred from the boiler immediately after having been cooked to a refrigerator with a temperature of about 32° F., to remain there until just before mealtime, when it may be removed for the necessary slicing.

Outbreaks of food poisoning due to infected salads that contain chicken or turkey meat left from a previous meal demonstrates what has been mentioned as excessive handling of food. Frequently such left-overs have not been stored in the chill room, but have been allowed to remain in some part of the galley where the temperature is favorable to contamination and to the rapid growth of bacteria. This type of meat provides an even better culture medium when it is cut in small pieces and mixed with the various ingredients characteristic of such salads. Experience has long since shown us that hash made from materials cooked on the previous day, is liable to produce an explosive outbreak of vomiting, abdominal cramps, nausea, prostration, and diarrhea. It is important to supervise the preparation of box lunches provided rifle-range parties, target-repair parties, picket-boat crews, and other groups that commonly leave their station early in the morning, and do not have the facilities to properly store highly perishable articles of food.

The manufacture of custards and custard fillings in the Navy must be given attention to insure the use of fresh materials, properly cleansed and sterilized equipment, adequate cooking, prompt cooling, avoidance of unnecessary handling, and other possible sources of contamination, and the adequate storage of the finished product under refrigeration with early consumption. These same precautions also apply to the local manufacture of ice cream.

Due to their highly perishable nature and the frequency with which they are involved in outbreaks of food poisoning of varying magnitude, the source of commercially produced bakery goods, including items with cream or custard fillings, all types of sandwiches, and ice cream, should be investigated and their sale in the ship's service stores regulated by competent medical authority.

Report on an Outbreak

On December 12, 1936, while at anchor at San Pedro, Calif., an outbreak of acute gastroenteritis occurred aboard the U. S. S. *Arizona* involving 124 members of the ship's company. All individuals that applied for treatment gave a history of eating cold boiled ham for dinner aboard the ship on the day of the outbreak. The onset of symptoms was sudden, between 2½ and 3½ hours after ingestion of the suspected ham, and was characterized by adbominal cramps followed by nausea and vomiting. Prostration was marked, and an occasional man suffered with severe cramps in the flexor muscles of the legs. Although the symptoms of gastroenteritis were violent in the majority of cases, except for some weakness, all but two men were well within a period of about 8 hours. Two individuals vomited frequently and passed watery stools repeatedly for about 24 hours, followed by marked weakness which gradually subsided on the third day. Treatment consisted of saline catharsis, camphorated tincture of opium, bed rest, external heat, and bland diet, depending upon the severity of symptoms.

Laboratory study:

1. Suspected ham: Under sterile precautions, specimens of meat were obtained from a whole ham immediately after the onset of the outbreak. Samples of ham were examined in the laboratories of the city of Long Beach, Calif., using Stone's differential medium. Colonies of a food poisoning type of hemolytic staphylococcus aureus were obtained. Colonies of this staphylococcus were transplanted from Stone's medium to broth, which in turn was fed to a kitten, producing an acute diarrhea in approximately 3 hours.

2. Stool examination: Cultures from stool specimens obtained from two cases with severe symptoms were reported negative for food poisoning organisms of the salmonella group.

3. Serum agglutination tests: Serum agglutination tests made on sera obtained from two cases of marked severity were reported positive in dilutions as follows:

	Case 1		Case 2	
	Serum obtained 6 days after attack	Serum obtained 14 days after attack	Serum obtained 6 days after attack	Serum obtained 14 days after attack
E. typhi	1:32	1:20	1:64	1:20
S. paratyphosus	1:16	1:20	1:16	1:10
S. schottmulleri	1:16	1:10	1:16	1:20

Facts regarding the suspected ham: The suspected hams were purchased under contract No. N 244 S 1935–6, and were received on board ship in acceptable condition on December 1, 1936. This shipment totaled 1,906 pounds, and was composed of sweet-pickle cured hams, type 1, regular or short cut, grade No. 2. Although these hams were of the "cured" variety, upon receipt aboard ship they were placed in a cold storage room, the temperature of which is maintained between 14° and 22° F. At 3 p. m. on December 10, 1936, about 500 pounds of this ham were removed from cold storage and placed in the butcher shop adjacent to the galley for thawing. On December 11, 1936, these hams were boiled from 9 a. m. to 1 p. m., then allowed to cool until about 3 p. m., at which time they were boned and placed in open pans on gratings in a passageway adjacent to the galley, where they reamined until about 10 a. m. on the following day, December 12, at which time they were returned to the galley for slicing and were served to the general mess at noon of that date.

Interview of the personnel involved in the boiling, boning, slicing, and handling of this ham revealed no instance of diarrhea, upper respiratory tract infection, furunculosis, boils, or other presumptive source of staphylococcus infection Flies were not present in the galley, but occasional cockroaches had been noted.

In addition to the general mess, all special messes of the ship served ham obtained from the same lot on the same day of the outbreak, although they were cooked in different galleys, and were handled in a somewhat different manner. The hams used by the wardroom mess, junior officers' mess, and chief petty officers' mess were boiled on December 11, but were again baked on December 12, before being served. The hams used in the warrant officers' mess also boiled on December 11, were placed in a refrigerator until served at noon of the following day. No individual who ate ham in any of these special messes suffered from symptoms of food poisoning. The remaining portion of the specified shipment of ham was consumed in the general mess during the subsequent 3 weeks at approximately 500 pounds per week, without untoward symptoms.

Summary

1. Staphylococci are frequently the causative organism in outbreaks of food poisoning and in isolated cases of acute gastroenteritis. Practically any food may be infected with staphylococci, although such infection ordinarily causes no change in the appearance, odor, or flavor of the food. Fresh milk, custards, and unrefrigerated cooked meats are frequently incriminated.

2. Differences between staphylococcus type and salmonella type of food poisoning include:

(*a*) Incubation period in staphylococcus food poisoning is between 2 and 4 hours as a rule, while in salmonella infection the period of incubation is commonly 6 to 12 hours.

(*b*) From the staphylococci isolated from that type of food poisoning may be obtained a bacteria-free filtrate, which when swallowed by human volunteers reproduces the symptoms of an acute gastroenteritis. Bacteria-free filtrates from salmonella cultures have been fed in large amounts to humans without producing any symptoms.

3. Only certain strains of staphylococci are capable of producing an enterotoxic substance and this characteristic is not entirely constant in any one strain. Staphylococcus enterotoxin is neutralized when added to gastric juice with a slightly acid reaction, suggesting one of the possible causes of the infrequency of this type of food poisoning in relation to the widespread presence of this organism.

4. A detailed quotation of Stone's cultural method of differentiating the enterotoxic and the nonenterotoxic strains of staphylococci is given.

5. The source of infection in this type of food poisoning is generally unknown, although respiratory droplet infection, contact with hands or objects contaminated with the discharges from various suppurative processes, and the transfer of organisms by flies and other insects have been implicated. Staphylococci have appeared in large numbers in the milk from apparently healthy cows.

6. The watchwords in the prevention of staphylococcus food poisoning are cleanliness and freshness of all foods, thorough cooking with a minimum amount of subsequent handling, pasteurization of milk, and the careful protection and refrigeration of all foodstuffs.

7. An outbreak of food poisoning due to ham, which was found by cultural and feeding tests to have been infected with a hemolytic Staphylococcus aureus, is reported.

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FOOD POISONING, UNITED STATES NAVAL STATION, GUANTANAMO BAY, CUBA

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On August 12, 1937, an outbreak of food poisoning occurred among men subsisted at the receiving barracks branch of the general mess of this station. The suspected food was corned-beef hash served for breakfast on that day. Members of no other mess were affected.

The menu in that mess was as follows: Fresh milk and cereal, corned-beef hash, catsup, hot cakes and sirup and coffee. The hash was prepared in the following

manner: 12 pounds of potatoes were boiled at 1600, August 11, and placed in the refrigerator overnight. At 0530, August 12, the hash was prepared from one 6-pound can of issue corned beef which appeared intact and the contents of which presented no unusual features to the cook on duty; 12 pounds of potatoes prepared as shown above; four fresh onions (U. S.); two 2-pound cans of tomatoes which appeared normal in all respects; ½ pint of Navy issue catsup. The hash was baked for 1 hour in an oven temperature of 350° to 400° F. and served over a period from 0650 to 0830. There was about half of a platter of hash left over at the conclusion of the meal, but, by the time patients began to report for treatment, this had been collected with the garbage and consumed by the hogs. It was therefore impossible to secure samples of the suspected food.

Out of a total of 55 men who ate breakfast in that mess on August 12, 20 reported as having eaten the hash in varying amounts. Of these 20, 16 were admitted to the dispensary for treatment, and while there was considerable variation in the other articles of food consumed at the meal, all 16 ate the hash. The earliest appearance of symptoms was recorded as 0930 and the latest 1200. Those reporting early appearance and greatest violence of symptoms were quite consistently those who consumed the greater amounts of hash.

Of general clinical features the following figures were obtained from the 16 men admitted for treatment:

Chills	6	Bitter taste	13
Fever	12	Vomiting	12
Headache	9	Diarrhea	15
Faintness	13		

Treatment given was symptomatic, eliminative, and supportive. One man who had eaten considerable amounts of the hash developed alarming symptoms of collapse but responded promptly to appropriate treatment. Two men lost sufficient fluid to require intravenous normal saline for the relief of severe muscle cramps. All patients were sufficiently recovered to be able to resume their duties early the following morning and were consequently carried on the binnacle list for August 12.

Although a sample of the suspected food could not be obtained, cultures were made on similar cans of ingredients in the galley. All were negative. Numerous cultures of vomitus and stools were made in nutrient broth and on plates of Endo's Media but all were negative. The epidemiological features and clinical aspects of the outbreak, however, were considered consistent with an infection by Salmonella enteritidis. Agglutination reactions done August 18, 6 days after the outbreak, on the three patients who were most severely affected gave results as follows:

		Dilution
Case No. 1	Salmonella enteritidis positive agglutination	1–640
Case No. 2	do	1–320
Case No. 3	do	1–320

From all data obtained, the following conclusions are drawn:

1. The contaminated food was corned-beef hash.
2. The causative organism was Salmonella enteritidis.
3. There was no direct evidence of contamination of any particular ingredient of the hash, but suspicion falls strongly on the corned beef.
4. There were no irregularities in the method of preparation of the hash.

STATISTICS

HEALTH OF THE NAVY

The following tables are summaries of morbidity rates per 1,000 for the third quarter of 1937 in comparison with rates for the corresponding quarter of the preceding 5 years:

ENTIRE NAVY

Year	All diseases	Injuries	Poisonings	All causes	Communicable diseases		Venereal diseases
					A	B	
1932	549	54	0.62	604	(1)	(1)	141
1933	404	65	7.10	476	9	86	115
1934	510	65	4.28	580	21	120	105
1935	373	53	.25	426	12	92	75
1936	336	60	7.18	404	24	88	49
1937	377	61	.46	439	20	101	59
FORCES ASHORE							
1932	544	85	0.93	629	(1)	(1)	107
1933	382	74	10.81	468	7	66	72
1934	637	91	1.35	730	31	181	64
1935	426	57	.20	484	14	127	43
1936	416	50	19.19	486	29	120	38
1937	508	63	.50	571	31	168	37
FORCES AFLOAT							
1932	552	37	0.45	590	(1)	(1)	159
1933	414	61	5.32	481	10	95	136
1934	449	53	5.69	507	16	91	125
1935	343	51	.27	395	11	72	92
1936	291	66	.30	357	21	70	55
1937	302	60	.43	362	13	63	72

[1] Not available.

Common infectious diseases of the respiratory type.—There were 2,406 admissions for these diseases reported from the entire Navy for the third quarter of the year 1937—1,214 from forces afloat, 1,043 from shore stations in the United States, and 149 from foreign shore stations. Catarrhal fever was responsible for 1,626 of the admissions.

Ships and shore stations reporting the largest number of cases were as follows:

	July	August	September	Total
Naval Training Station, San Diego, Calif	70	85	98	253
Naval Training Station, Newport, R. I	52	42	88	182
Naval Training Station, Norfolk, Va	48	46	27	121
Brigade Hospital, Shanghai, China	27	33	37	97
Marine Barracks, Quantico, Va	29	28	27	84
Naval Training Station, Great Lakes, Ill	25	13	13	51
U. S. S. *Tennessee*	21	23	7	51
U. S. S. *Saratoga* (fleet air detachment)	8	13	25	46
U. S. S. *Ranger*	2	12	26	40
Marine Corps Base, San Diego, Calif	20	11	7	38
Fleet Air Base, Pearl Harbor, Hawaii	4	19	12	35

Mumps.—The U. S. S. *West Virginia* reported 39 cases of mumps during the quarter, 12 in July, 19 in August, and 8 in September; the U. S. S. *Tennessee*, 2 in July, 12 in August, and 5 in September; and the Naval Training Station, Norfolk, Va., 6 in July, 12 in August, and 1 in September.

Chickenpox.—Eight cases of chickenpox were reported for the quarter, as follows: In July, 1 each from the U. S. S. *Idaho*, U. S. S. *Medusa*, U. S. S. *Oklahoma*, and the Submarine Squadron No. 4; and in August, 2 from the U. S. S. *Detroit*, 1 from the U. S. S. *Pensacola*, and 1 from the U. S. S. *Smith*.

Cerebrospinal fever.—Two cases of cerebrospinal fever were reported for the quarter. An apprentice seaman, 19 years of age, with 4 months' service, was transferred from the U. S. S. *Tuscaloosa* on August 13, 1937. No disposition has been made of this case at the end of the third quarter.

A midshipman first class, 20 years of age, was transferred from the U. S. S. *New York* to the Norfolk Naval Hospital, Portsmouth, Va., on August 13, and discharged from the sick list on September 4, 1937.

Typhoid and paratyphoid fevers.—A moderately severe case of typhoid fever (a fireman, first class, 26 years of age, with 7 years and 9 months' service) was admitted to the sick list at the Naval Proving Ground, Dahlgren, Va., on September 23, 1937, and transferred to the Naval Hospital, Washington, D. C. Two courses of straight typhoid vaccine had been completed in January 1930 and March 1935. The questionnaire in this case states:

> Place and source of infection unknown. There had been an epidemic of typhoid fever in the county and the patient had been drinking questionable water.

Relative to the incidence of typhoid fever in this section of Virginia, the medical officer of the Naval Proving Ground, Dahlgren, Va., under date of August 3, 1937, reports as follows:

> During the past 2 weeks, an epidemic of typhoid fever has occurred in King George County, Va. It was first reported to this office by a member of the county board of health on July 27, 1937. As closely as could be estimated, there are 27 cases * * * all about 15 miles distant from this station.

One mild case of paratyphoid fever B, without complication, was admitted to the sick list from the Marine detachment, American Embassy, Peiping, China, in July. A course of typhoid vaccine had been completed in December 1935.

Poliomyelitis, anterior, acute.—One case of poliomyelitis occurred in an enlisted man while on leave from the United States Naval Air Station, San Diego, Calif. The senior medical officer of the Naval Training Station, Great Lakes, Ill., reports that "he is being carried at this station while a patient in the United States Army Hospital, Fort Leavenworth, Kans."

During the month of September 1937, three cases of poliomyelitis, anterior, acute, occurred in one company on the Naval Training Station, San Diego, Calif. The first case was admitted on September 8 and transferred to the hospital on September 11 where diagnosis was confirmed. The swimming pool was closed; the entire company and company commanders were placed in strict quarantine; separate messing facilities were provided; members of the company were examined by a medical officer twice daily, and a nasal spray given daily for 3 successive days and weekly for the following 2 weeks; contacts were placed in quarantine; all bedding was aired and sunned daily; and the men were encouraged to restrict close or intimate contact with each other.

On September 13, the day quarantine was established, another member of this company complained of general malaise and symptoms of a common cold. A complete physical examination at this time by the medical officer of the day showed normal reflexes and no symptoms other than those indicated above. He was transferred to the hospital and diagnosis of poliomyelitis was established. He developed paralysis of the muscles of deglutition, then of the deltoids, and later of the muscles of respiration, and died on September 16.

The third case was transferred to hospital on September 15. The patient complained of nausea and general malaise and later developed stiffness of the lumbar muscles.

In summarizing, the medical officer reported as follows:

1. Three cases of poliomyelitis were found in one company of recruits containing 97 men.
2. The source of infection points to San Diego and vicinity where 39 cases have been reported during the last 3 months.
3. The value of the preventive measures employed is not known.

Scarlet fever.—One case was reported in July by the U. S. S. *West Virginia* and one case in August by the Naval Training Station, San Diego, Calif.

Diphtheria.—In July, a private, Marine Corps, 25 years of age, with 2 years and 11 months' service, was admitted to the sick list with diphtheria from the Marine detachment, American Embassy, Peiping, China. He was discharged to duty after 8 sick days.

INJURIES AND POISONINGS

Admissions For Third Quarter Ending September 30, 1937

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the third quarter, 1937, is based upon all Form F cards covering admissions in those months which have reached the Bureau:

	Admissions, July, August, and September, 1937	Admission rate per 100,000, per annum	Admission rate per 100,000, year 1937
INJURIES			
Connected with work or drill	744	2, 264	2, 513
Occurring within command but not associated with work	644	1, 960	1, 924
Incurred on leave or liberty or while absent without leave	615	1, 872	1, 760
All injuries	2, 003	6, 096	6, 197
POISONINGS			
Industrial poisoning	2	6	7
Occurring within command but not connected with work	9	27	211
Associated with leave, liberty, or absence without leave	4	12	18
Poisonings, all forms	15	46	236
Total injuries and poisonings	2, 018	6, 142	6, 434

PERCENTAGE RELATIONSHIPS

	Occurring within command				Occurring outside command—leave, liberty, or A. W. O. L.	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty			
	July, August, and September, 1937	Year 1936	July, August, and September, 1937	Year 1936	July, August, and September, 1937	Year 1936
Percent of all injuries	37. 1	40. 6	32. 2	31. 0	30. 7	28. 4
Percent of all poisonings	13. 3	3. 0	60. 0	89. 5	26. 7	7. 5
Percent of total admissions, injury and poisoning titles	37. 0	39. 2	32. 3	33. 2	30. 7	27. 6

Note.—Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction" or "alcoholism," as the case may be. Such cases are not included in the above figures.

MORBIDITY

Summary for the Third Quarter Ending September 30, 1937

Average strength	Forces afloat, 83,195		Forces ashore, 48,238		Entire navy, 131,433	
	Admissions	Rate per 1,000	Admissions	Rate per 1,000	Admissions	Rate per 1,000
All causes	7, 532	362. 14	6, 884	570. 84	14, 416	438. 73
Diseases only	6, 275	301. 70	6, 123	507. 73	12, 398	377. 32
Injuries	1, 248	60. 00	755	62. 61	2, 003	60. 96
Poisonings	9	. 43	6	. 50	15	. 46
Communicable diseases transmissible by oral and nasal discharges (class VIII):						
(A)	272	13. 08	370	30. 68	642	19. 54
(B)	1, 300	62. 50	2, 026	168. 00	3, 326	101. 22
Venereal diseases	1, 495	71. 88	445	36. 90	1, 940	59. 04

DEATHS

During the Third Quarter Ending September 30, 1937

Cause		Navy			Marine Corps		Nurse Corps	Total
Primary	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
Average strength		9,813	2,190	100,651	1,335	17,045	399	131,433
DISEASE								
Abscess, intra-abdominal	Peritonitis, general, acute.	1						1
Addison's disease	None			1				1
Alcoholism, acute	Exhaustion from overexertion.	1						1
Appendicitis, acute	None					1		1
Do	Obstruction, intestinal, from spastic or paralytic causes.			1				1
Do	Peritonitis, general, acute.			1				1
Arteriosclerosis, general	Heart block	1						1
Carcinoma:								
Lung	None	1						1
Pancreas	do			1				1
Cellulitis, face	Septicemia			1				1
Embolism, mesenteric artery.	Varicocele, leg			1				1
Endocarditis, subacute	None			1				1
Hemorrhage, cerebral	do			1		1		2
Hodgkin's disease	do			1				1
Leukemia	do			1				1
Myocarditis, chronic	Arteriosclerosis, general			1				1
Otitis media, chronic	Abscess, brain			1				1
Pneumonia, lobar	None	1						1
Poliomyelitis, anterior, acute	do			1				1
Thermic fever (therapeutic)	Gonococcus infection, joint.			1				1
Thrombosis, cerebral	None			1				1
Thrombosis, coronary	do					1		1
Do	Arteriosclerosis, general					1		1
Tonsilitis, chronic	Abscess, lung			1				1
Tuberculosis, pulmonary, chronic.	None			2		1		3
Do	Meningitis, cerebrospinal, acute.			1				1
Tumor, malignant, mixed, (adenocarcinoma) stomach	None					1		1
Sarcoma, lung	do						1	1
Sarcoma, thymus, heart and pericardium.	do			1				1
Ulcer, stomach	Atelectasis			1				1
Total for disease		5		21		6	1	33
INJURIES AND POISONINGS								
Burn, entire body (steam)	None			1				1
Crush, head	do			1				1
Drowning	do	3		12		2		17
Fracture, compound, frontal	do	1						1
Fracture, compound, skull	do	1		4		1		6
Fracture, compound, femur	Hemorrhage, traumatic, femoral artery.			1				1
Fracture, compound, ribs	Hemorrhage, pulmonary			1				1
Fracture, compound, temporal.	None			1		1		2
Fracture near joint with dislocation, cervical vertebrae.	Intraspinal injury			1				1
Fracture, simple, hyoid	None					1		1
Fracture, simple, occipital	Intracranial injury					1		1
Fracture, simple, skull	None					1		1
Do	Intracranial injury			1				1
Fracture, simple, vertebrae, cervical.	None	1						1
Injuries, multiple, extreme	do	8		9		3		20
Do	Aerogenes capsulatus infection, ankle.	1						1

During the Third Quarter Ending September 30, 1937—Continued

Cause: Primary	Cause: Secondary or contributory	Navy: Officers	Navy: Midshipmen	Navy: Men	Marine Corps: Officers	Marine Corps: Men	Nurse Corps	Total
INJURIES AND POISONINGS—Continued								
Intracranial injury	None			2				2
Intraspinal injury	do			2		1		3
Rupture, traumatic, liver	do			1				1
Rupture, traumatic, lung	Emphsyema, traumatic, mediastinum.			1				1
Sunstroke	None			1				1
Strangulation, neck	do					1		1
Wound, gunshot, chest	do			1		1		2
Do	Hemorrhage, traumatic, axillary artery.			1				1
Wound, gunshot, heart	None			1				1
Wound, gunshot, head	do			1		1		2
Wound, lacerated, abdomen	do			1				1
Wound, lacerated, perineum	do			1				1
Poisoning, acute, sulphanilamide.	Agranulocytosis and gonococcus infection.			1				1
Total for injuries and poisonings.		15		46		14		75
Grand total		20		67		20	1	108
Annual death rate per 1,000:								
All diseases		8.15		2.66		4.69	10.03	3.29
Disease only		2.04		.83		1.41	10.03	1.00
Drowning		1.22		.48		.47		.52
Poisoning				.04				.03
Other injuries		4.89		1.31		2.83		1.73

MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

Statistics for Third Quarter Ending September 30, 1937

The following statistics were taken from sanitary reports submitted by naval training stations:

July, August, and September 1937	United States naval training station: Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	983	745	851	1,274
Recruits appearing before Board of Medical Survey	6	0	7	0
Recruits recommended for discharge from the service	6	0	7	0
Recruits discharged by reason of medical survey	4	0	(1)	0
Recruits held over pending further observation	0	3	(1)	0
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	0	20	58	56

[1] Not reported.

The following table was prepared from reports of medical surveys in which disabilities or disease causing the surveys were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Abscess, periapical	1	Dysinsulinism	1
Absence, acquired, teeth	5	Effort syndrome	1
Acne, chronic	1	Enuresis	27
Adhesions (intestinal)	1	Epilepsy	7
Adhesions, right leg	1	Flat foot	10
Amblyopia	1	Goiter, exophthalmic	1
Ankylosis, tarsal, metatarsal, and ankle joints	1	Glycosuria	1
Arterial hypertension	1	Hemorrhoids	1
Asthma	3	Malformation, congenital	1
Astigmatism	2	Malocclusion, teeth	2
Atrophy, muscle, thigh and leg	1	Migraine	2
Bronchitis, chronic	1	Myopia	2
Caries, teeth	3	Nephritis, chronic	1
Cholecystitis, chronic	1	Neurosis, traumatic	1
Cicatrix, skin	2	Otitis, media, chronic	4
Colitis, chronic	1	Perforated nasal septum	1
Congenital heart disease	1	Pes cavus	2
Constitutional psychopathic inferiority, without psychosis	9	Poliomyelitis, anterior, chronic	1
Constitutional psychopathic state, emotional instability	1	Prostatitis, chronic (nonvenereal)	1
Constitutional psychopathic state, inadequate personality	2	Psychoneurosis, hysteria	5
Constitutional psychopathic state, paranoid personality	1	Psychoneurosis, neurasthenia	1
Deafness, unilateral	3	Rhinitis, atrophic	1
Defective physical development	1	Somnambulism	2
Deformity, acquired, left shoulder	2	Stammering	1
Deformity, acquired, loss of flexion, finger	1	Strabismus	2
Deformity, acquired, right femur (old fracture)	1	Syphilis	6
Deformity, acquired, left ankle (old fracture)	1	Trichophytosis	1
Dementia praecox	3	Tuberculosis, pulmonary, chronic, active, moderately advanced	1
		Union of fracture, faulty	3
		Valvular heart disease, mitral insufficiency	4
		Valvular heart disease, mitral stenosis	1
		Varicocele	1

VOLUME XXXVI JULY 1938 NUMBER 3

United States Naval Medical Bulletin

PUBLISHED *for the* INFORMATION OF THE MEDICAL DEPARTMENT *of the* NAVY

THE MISSION OF THE MEDICAL CORPS OF THE NAVY

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TO KEEP AS MANY MEN AT AS MANY GUNS AS MANY DAYS AS POSSIBLE

Issued Quarterly by the Bureau of Medicine and Surgery
Washington, D. C.

VOL. XXXVI JULY 1938 No. 3

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

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PREFACE

The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, and reports from various sources, notes, and comments on topics of medical interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

P. S. ROSSITER,
Surgeon General, United States Navy.

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The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received at least 3 months prior to the date of the issue for which they are intended.

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The BULLETIN intends to print *only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.*

EBEN E. SMITH, *Editor,*
Commander, Medical Corps, United States Navy.

U. S. NAVAL MEDICAL BULLETIN

VOL. XXXVI — JULY 1938 — No. 3

SPECIAL ARTICLE

FIELD SANITATION [1]

By Captain W. L. MANN, Medical Corps, United States Navy.

Health is necessary in war, and cannot be replaced by anything else—Napoleon

INTRODUCTION

One of the prime requisites for victory is health. An army to fight has figuratively and literally to "take the field," consequently field hygiene and sanitation is one of the most important subjects for military sanitarians, because the laws of preventive medicine are then made applicable to war as a matter of military economics and this adaptability to wartime conditions is the supreme test of all military efficiency.

The functions of a military medical organization may be roughly divided into (*a*) prevention of disease and (*b*) treatment of disease and injury. Prevention of disease is of vast importance to the military personnel, and this function only will be considered in this article.

To a well informed person, the laws of field sanitation may appear so elementary that a study of them would seem unnecessary and probably a waste of time, but when one stops to consider, for example, that the simple measure of mosquito control alone made the building of the Panama Canal possible, one may obtain a slight idea of the vast economic importance of such a preventive measure. It has been stated that in the construction of the 28-mile railroad across the Panama Isthmus, the number of wooden railroad ties approximated

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[1] AUTHOR'S NOTE.—The major portion of this information was originally prepared for instruction purposes at the Marine Corps Schools, Marine Barracks, Quantico, Virginia. The writer wishes to acknowledge the assistance received from Lieutenant H. E. Gillespie, Medical Corps, United States Navy, and Chief Pharmacist R. N. Cheetham, United States Navy, in the compilation of these data.

EDITOR'S NOTE.—This article presents the author's prolonged experience and extensive research in a field which has been his primary service interest. It is a major revision of material published by the Bulletin in 1923 which has since served as an authoritative reference and is particularly valuable in that it presents a compilation of information relatively inaccessible to naval medical officers. This material is based on experience gained by medical officers on field service. Much credit is due and is extended with appreciation to the medical services of the U. S. Army and His Majesties medical officers serving with the British Army for the wealth of information on military medicine they have made available.

the number of men dying from malaria and yellow fever, diseases transmitted by the mosquito. In other words a death resulted for every few feet of construction. It is not improbable that the World War would have been terminated by epidemic diseases in the second year had not certain, apparently simple, sanitary measures of waste disposal been observed. The care of the feet and shoe fitting constitute other simple field measures that assume great magnitude from a military standpoint. At least 25 percent of a marching command may suffer from foot injuries, and the European Armies estimate 10 percent of the marching army will be incapacitated from "sore" feet when an army first takes the field.

Tact and a certain amount of technical ability are necessary qualifications for a successful sanitarian. Sanitation is so closely interrelated with cleanliness that the major portion of the duty of a sanitation officer consists in the supervision of cleanliness.

To induce other individuals to maintain their persons and premises in a clean condition, without arousing a certain amount of friction and antagonism, is not always an easy matter, hence the *modus operandi* should depend upon the circumstances. As a rule friction is exceedingly rare and there is complete cooperation of the combatant forces in enforcing all necessary sanitary recommendations. However, if cooperation is not as prompt as desired, there should be no quibbling over details, but a receptive attitude should be cultivated. The majority of the functions of the sanitation officer are considered purely advisory, and here his responsibility ceases.

As a general rule sanitary recommendations should be reduced to a minimum and should be concise as possible. All recommendations should be carefully considered, and those which are not of essential importance should be omitted. If practicable, preface sanitary recommendations with an explanation, as commanding officers usually desire to know the reasons for promulgating orders and placing restrictions on personnel.

Preventive medicine is not an exact science nor is it possible to obtain 100 percent efficiency. However, if by careful attention to the minor details the sanitation officer is able to increase military efficiency from 96 percent to 98 percent, he has not gained a mere increase of 2 percent as it may seem, but has effected a gain of 50 percent—that is, the noneffective rate has been reduced from 4 percent to 2 percent. It is this little difference which sometimes may be the deciding factor between victory and defeat.

Field sanitation contrasted with sanitation of garrisons.—The differences between field sanitation and sanitation of garrisons are marked.

1. Field sanitation is easier to institute. For example, the devices used for the disposal of waste are of simple construction, whereas the installation of a water-carriage sewerage system requires more expert engineering knowledge, takes longer to construct, and by reason of its permanent nature is more expensive.

2. Constant vigilance is required to maintain field sanitary devices in proper sanitary condition.

3. Field sanitary appliances are a potential menace, if not properly maintained.

In established garrison life, with water-carriage waste disposal, an adequate and potable water supply, permanent housing facilities, protective screening for insect control, and similar modern developments, the duties of the sanitation officer are comparatively simple and more or less routine. In the field, the conditions are such that the field sanitary devices require constant and painstaking personal supervision from both the line and the medical officers in order that there may not be a weak link in the chain of sanitary measures.

Barracks life may give us comparatively little concern, but when we take the field, vigorous sanitary measures must be instituted and maintained and, if possible, improved from day to day.

The commanding officer of an organization is responsible for the health of his command and the enforcement of sanitary measures. The British Field Service Regulations state: "Every officer is responsible that all orders affecting the health of an army are rigidly carried out by the troops under his command. Neglect of sanitary precautions inevitably results in great loss of life and efficiency." The regulations of United States Army and United States Navy are equally explicit on this subject.

The medical department acts in an advisory capacity. The medical officer is charged with the initiative in making necessary recommendations to the commanding officer tending to the promotion of health and prevention of disease. For instance, the medical officer should recommend the type, number, and regulation of sanitary devices, but the responsibility for the actual construction and the maintenance of the same in a sanitary condition rests with the respective unit commanders. Likewise the collecting company of the medical battalion exercises supervision over sanitation, but the latrines, urinals, incinerators, etc., should be constructed by a detail from other units.

War and biology.—Almost without exception, it is characteristic of all animal life to be gregarious. As density of congregation increases, natural laws tend to limit excessive multiplication by the reaction of infectious and autogenous toxic products upon the mass.

Otherwise any species, increasing as it does by geometrical progression, would in a short period of time, relatively speaking, tend to inhabit the earth to the exclusion of all other species.

There is a constant combat of species for existence, each species exists in its own little niche, and excessive multiplication tends to be limited by other species.

In order to demonstrate the excessive productiveness of a single species, a biologist has computed the unrestricted fecundity of the elephant, the slowest propagating mammal. This authority claims that if a pair of elephants were allowed to multiply under optimum and unrestricted conditions for 2,000 years, there would not be standing room in the world for their descendants.

If we assume the number of generations of a breeding female fly as nine in a normal season, then a single fly laying 150 eggs at a time might conceivably become ancestress to 5,000,000,000,000,000,000,000,000,000,000 descendants in one season. The student may compute the bulk of this mass and picture what would happen in 10 years, if the fecundity of this single fly were not halted by biologic laws.

All species, including man, multiply in geometrical progression, but the best we can expect of the increase in food supply is arithmetrical progression, according to the Malthusian doctrine (T. R. Malthus, 1766–1834).

To show that natural laws must inhibit human productiveness, it has been stated that a man and wife at the time of Christ with two children and each of their descendants have two children, and no intermarriages of descendants take place, allowing 34 years for a generation, or a total of 57 generations, the human offspring now alive would total 72 quadrillion persons. If this number passed in review, at the rate of 8 million persons per hour, the parade would last for a million years. Rather fantastic but true.

Limitation of food supply, the spread of contagious diseases, war, and conflict of races, are methods of restriction of excessive multiplication of the human species.

When we place a million men in the field and prevent decimation from disease, we are defying one of the biological principles that tends to prevent over-crowding of a species. The methods at our disposal to combat these fundamental biological principles are not complicated and may be classified and will be discussed as follows:—

1. Proper food.
2. Potable water supply.
3. Hygiene of the march.
4. Conservancy—waste disposal.
5. Insect control—fly, mosquito, louse, etc.

MODERN PREVENTIVE MEDICINE

Wars are lost by generals and won by epidemics

Victory, success in a military endeavour, is intimately interrelated and dependent upon personnel losses; in fact, the wastage from diseases frequently assumes such magnitude as to cause military campaigns to terminate in disaster.

According to one writer, the body louse, transmitter of typhus, won the World War. For example, the Austrian Army feared to invade Serbia in 1915 due to an epidemic of typhus which killed 150,000 persons in 6 months of that year; and, again, in Russia 25,000,000 cases with 3,000,000 deaths from this disease aided the spread of revolution and the complete collapse of Russia's huge army.

"Typhus and allied diseases have decided more campaigns than Caesar, Hannibal, Napoleon, and all the generals in history. The epidemics get the blame for defeat; the generals the credit for victory. It ought to be the other way around."

As examples of the influence of different diseases upon the outcome of military ventures the following are cited.

Yellow fever.—At the beginning of the last century (1802) 50,000 out of an Army of 58,000 died on Santo Domingo island from yellow fever.

Typhoid fever.—In the Spanish-American War, the American forces lost about 10 times as many men from typhoid fever as were killed in combat. After compulsory vaccination against typhoid only three cases, and no deaths, occurred in the entire American Army of 90,000 men over a period of 5 years.

Cholera.—In the Balkan War, the Turks lost as many as 500 men daily from cholera. The allies lost 10,000 men from cholera in Crimea in 1854.

Plague.—The Persians under Xerxes were defeated in an attempt to invade Greece by an epidemic of plague; Athens was forced to surrender as a result of this disease, and the sieges of Syracuse in 414 B. C. by the Athenians, and in 396 B. C. by the Carthaginians were failures caused by the plague in these armies. In the war between Russia and Turkey in 1828, plague killed over 6,000 Russians in 1 month, and from all causes the Russian Army of 100,000 suffered 85,000 deaths, and at one time had half of its total strength in the hospital.

Typhus.—In the 1566 campaign against the Turks, Maximillian II of Germany failed on account of typhus. A typhus epidemic among the Austrian defenders of Prague in 1741 enabled the French to capture this city. In the Bavarian Army of 28,000 men in 1812,

25,000 died of typhus fever. After the battle of Plovna, the Russians lost 60,000 men from typhus out of a strength of 120,000. Napoleon lost 40,000 from typhus during his retreat from Moscow and after arrival in Paris.

Malaria.—Malaria, probably introduced in ancient Rome during the Carthaginian invasion, so debilitated the Roman forces that they succumbed to the inroads of the Barbarians. In the Walcheren Campaign of 1809, the English forces had 10,000 sick and 4,000 died from malaria. The English at Ashanti in 1864 "were defeated" by malaria before an enemy was seen. The French expedition at Madagascar (1895) had a death rate of 320 per 1,000 from malaria, yet suffered only 15 deaths in action. In Macedonia, the British forces had 162,517 admissions to hospitals from this cause; one division reported 5,000 cases in 1 month. The highest annual rate was in South Africa in 1917, when the rate per thousand was 1,422.84. Malaria caused the death of 15,000 soldiers in the Civil War, while we lost only 25 during the World War from this cause.

Beri-beri.—This was once a disease dreaded by the forces afloat, and has been a factor in deciding naval ventures. Not so long ago, one of the modern navies showed an incidence rate of 35 percent from this malady, which was reduced to a negligible rate by the introduction of vitamin "B" in the sea ration. In the Russo-Japanese War, 1905, the Japanese army had 200,000 cases of beri-beri.

Scurvy.—In one of Commodore Anson's naval ventures 19 out of every 20 men failed to return to England, the majority dying of scurvy. The American frigate *Macedonia*, from April to September 5, 1827, lost 101 men out of a crew of 376. In the Crimean War (1854–56) 23,000 cases of scurvy occurred among the French troops alone; in the American Civil War (1861–65) 30,174 cases were diagnosed. In the siege of Port Arthur, during the Russo-Japanese War, 85 percent of the Russian garrison suffered from scurvy.

Dysentery.—The siege of Bagdad by the Saracens in 1439 failed as a result of an epidemic of dysentery. Metz was saved from Charles V partly on account of dysentery. Frederick Wilhelm II of Prussia in 1792 was unable to fight the Army of the French Revolution and was forced to retreat into Germany because of dysentery among his troops. Dysentery caused 1,342 deaths and 38,000 cases of sickness during the South African War. At Gallipoli, during August and September 1915, 78 percent of the British troops were suffering from dysentery and other intestinal complaints.

Smallpox.—Mecca was saved by smallpox which decimated the Saracens. Smallpox was one of the causes of the military failure of Benedict Arnold's campaign against Quebec. In 1870 the French lost 23,000 men from this disease, whilst the Germans who were exposed

to the same contagion, but were efficiently revaccinated, lost only 200 men—a striking illustration of the military value of vaccination.

Smallpox took over 7,000 lives during the Civil War; in the World War it took only 14 lives in our troops.

Beginning with the Russo-Japanese War, the ratio of deaths from disease began to decrease due to improvement in modern field sanitation. This change is particularly evident when this war is compared with the Chino-Japanese War occurring 10 years earlier.

The following table demonstrates the striking improvement of health of military forces due to employment of modern sanitary measures.

Ratio of killed in action to deaths from disease in various campaigns

Campaign	Approximate average strength during campaign	Ratio per 1,000 per annum	
		Killed in action	Died from disease
Crimean War—1854-56:			
French troops	301,000	30.6	114.7
English troops	111,000	16.8	87.3
United States Civil War—1861-65:			
Federal troops	600,000	38.3	75.9
Austro-Prussian War 1870-71:			
Prussian troops	437,000	61.1	88.2
Chino-Japanese War 1894-95:			
Japanese troops	227,000	7.3	88.1
Madagascar, 1895:			
French troops	18,000	.48	373.3
Spanish-American War 1898:			
American troops	270,000	2.5	32.6
Boer War, 1899-1902:			
British troops	208,226	12.7	25.6
Russo-Japanese War 1904-05:			
Japanese troops	420,000	88.5	40.8
Russian troops	490,000	61.3	35.8
German S. W. Africa 1903-06:			
German troops	18,000	13.5	12.9

NOTE.—In France and Flanders, during the World War, the British forces lost 585,533 men killed by the enemy and during the same period only 32,096 died from disease.

FOOD IN THE FIELD

An army fights on its stomach—Napoleon

In war the supply of food is most important. The men attached to an organization on field duty are not likely to have opportunity to supplement the military ration by purchases from civilian restaurants or other eating places to supply any deficiencies in their daily ration. Hence, it is important that the field ration be well balanced in fats, proteids, and carbohydrates and must have the required vitamin content.

An extended discussion of the component parts of a well balanced ration would be a departure from our subject and, as such data may be found in textbooks, only certain aspects of a military ration which are related to field conditions will be considered.

CALORIC VALUE OF THE MILITARY RATION.—It has been found that a ration consisting of 3,700 Calories is insufficient for troops in the front line. It has been experimentally proved that troops on a test march can maintain weight on a ration of 4,100 Calories.

If troops must entrench after a day's hike, a total of 5,000 to 6,000 Calories per day is required. It is often impractical for a soldier to assimilate such a large number of calories per day, and consequently, in time of war soldiers are allowed a greater amount of food (often at the expense of the civilian population) so that they may have a reserve supply of fat in the body to enable them to temporarily withstand the unusual expenditure of foot-pounds of energy. It is stated that 20 pounds of reserve fat in a man's body will supply 3,000 additional Calories per day for a period of 30 days.

The following is the caloric value of the United States Army ration:

	Calories
1. Reserve (haversack ration)	2,825
2. Mobile	3,500
3. Normal	4,125
4. Special	4,850

The heat of hot drinks and hot food supply additional calories, 1 pint of hot tea adding 50 Calories of direct heat to the body. Hence the stimulating effect of hot tea, coffee, soup, and broth after a long march.

A soldier at hard work requires 24 ounces of food, daily, exclusive of water, made up as follows:

	Ounces
Proteins	4
Carbohydrates	17
Fats	3

In terms of articles of food, the above is represented by the following field ration:

Beef	ounces	11	Sugar	ounces	2
Cheese	do	3	Jam	do	2
Bread	do	16	Sago	do	4
Potatoes	do	10	Milk	pint	½

The nitrogenous foods (proteins) serve for the building and repairing of tissues, and also serve for the maintenance of heat and energy.

The carbohydrates and fats yield heat and energy. The salts are essential to life and health, and for the formation of the skeleton and tissues. Water is as essential a food as the foregoing, and serves for the solution and conveyance of food to the various parts of the body, and also for the removal of the waste products formed in the

body, viz the solid and liquid excreta. Water alone, by its evaporation from the skin, assists in stabilizing the temperature of the body.

A part of the water required by every one is contained in the solid food taken, of which it forms a very large proportion; meat, for instance, contains about 75 percent water, some vegetables as much as 90 percent, and bread about 38 percent.

The amount and the particular kind of foodstuffs required by an individual will vary with his age, his build, his work, and the climate in which he works.

In cold climates a man will require more of the heat-producing foods, especially fats, and in a hot climate he needs less of the nitrogen-containing foods and fats, and more of the vegetable food stuffs.

The greater amount of muscular energy required, the greater will be the amount of food necessary to supply this energy.

Energy value is generally expressed in calories, a Calorie (kilo calorie) being the energy in the form of heat, required to raise the temperature of 1 pound of water 4° F. (Or 1 kilogram of water 1° C.)

It has been found by experiment that 1 gram of protein or carbohydrate is capable of yielding, by its oxidation in the body, 4.1 Calories, and 1 gram of fat, 9.3 Calories.

The British army ration gives the following:

Protein 175 grams	× 4.1 equals	717 Calories.
Fat 218 grams	× 9.3 equals	1, 927 Calories.
Carbohydrates 515 grams	× 4.1 equals	2, 111 Calories.
	equals	4, 755 total Calories

DAILY MENU.—It is advisable to prepare the daily menu at least 24 hours in advance. The medical officer should carefully scrutinize the menu, and not only inspect the food as to quantity and quality, but the necessary precautions should be taken to see that there is a variety of food prepared.

There is often a tendency for cooks to prepare an excess of stews, which may cause dissatisfaction among the men. When on the march or otherwise heavily worked, the men will have a craving for sweets; a liberal amount of jam should be provided to satisfy this craving.

The presence of much refuse food in the garbage can is a good indication that the men are not receiving the proper kind of food, that it is not palatably cooked or served, or the quantity is excessive.

The field ration should contain tomatoes, lemon or orange juice whenever practical. Potatoes should be cooked and eaten unpeeled, thus supplying additional vitamins. Fruit and vegetables which are to be eaten raw and unpeeled, should have the exterior surface steri-

lized by temporary immersion in boiling water whenever there is suspicion of soil contamination being present.

Every effort must be made to vary the field diet to the greatest possible extent, changing the food substances as well as the manner of cooking.

The guard at night should have coffee and bread before going on duty, and this should apply to relief parties.

Field kitchens.—The use of rolling kitchens on the march has superseded the old method by which each man cooked his own food. One rolling kitchen supplies food for 200 to 250 men. The field kitchen should be located on the opposite side of the camp from the latrines and urinals. Some means should be used to protect the food from dust and sand. If circumstances permit, the kitchen should be screened; if not, other precautions should be taken to protect food from flies and other insects. Burlap sacking may be used for screening when more suitable material is not available.

There should be on hand at all times a sufficient supply of pure water and material for cleaning purposes, such as soap, soda, and soap powder. Scouring material, boiling water, and dishcloths should be available.

If the kitchen has a dirt floor it may be oiled with used motor oil to control dust.

The cooks and other attendants working in the kitchen and handling food should be instructed in personal hygiene. Rigid supervision is necessary to prevent the cooks from becoming lax in personal cleanliness, especially in keeping the hands and finger nails clean.

Physical examination of all food handlers should be made at regular intervals; and if the laboratory facilities permit, an effort should be made to detect and eliminate any disease carriers among them. Routine venereal inspections should be made.

Liquid and solid refuse should be disposed of as soon as practical. The outside of all garbage cans should be kept clean, and covered at all times.

The object of cooking processes is—

(*a*) To make food more digestible and appetizing.
(*b*) To destroy germs and parasites.

Mess halls.—The mess halls should be located near the kitchen.

Make the necessary provisions to protect the food in the mess halls from flies, dust, and sand, using wire screening if available.

Clothes and toilet articles must not be stored in kitchens or mess halls.

The mess tables should be cleaned and sunned at regular intervals and care must be taken to see that food particles do not collect in the cracks of the tables.

One of the best methods to prevent the collection of food particles in the cracks of the tables is to construct the tables with a removable center board which may be lifted off, and thus permit the cleaning of the cracks between the boards. Another method is to construct the tables with a 2-inch space between the boards.

Washing mess gear in the field.—After meals all mess gear should be sterilized in boiling water. In a semipermanent camp the mess gear may be placed in wire racks and washed by immersion for 5 minutes in water that is kept boiling.

On the march and under conditions where the mess kits from the haversack are in use, the following method of washing the individual mess gear is employed:

Immediately after the men have finished eating they should form a line and pass a garbage can or pit where the refuse liquid and solid food are disposed of. After disposing of this refuse food each man inserts his mess gear successively in three cans. These cans are placed over a trench in which a fire is burning. The first and second cans contain boiling soapy water, while the third can contains boiling clear water. A few moments insertion in each of these cans is usually sufficient to cleanse and partially sterilize the utensils. After insertion in the third can, the mess gear dries by its own heat almost immediately and no wiping is necessary. Care should be taken to see that the water in each can is kept at a boiling point, as lukewarm dishwater is a potent factor in the dissemination of saliva-borne diseases.

It appears that the military sanitarians have waged a successful battle against intestinal disease, but during the Great War sputum-borne diseases of the respiratory tract, such as influenza and pneumonia, did not always yield so readily to preventive sanitary measures.

During the Civil and Spanish-American Wars the intestinal diseases were prevalent, while in the recent world conflict more persons died from respiratory diseases than any other group of diseases.

Protection, storage, and inspection of food supplies.—Surplus and reserve food supplies should be protected from insects such as flies and roaches, from dust and dirt, and from rats and mice. Perishable foods should be stored at a temperature that will inhibit the growth of moulds and bacteria. For camps of less than 1 week's duration, storage devices for preservation of food are not necessary.

1. In temporary camps food may be stored in watertight containers and immersed in springs or streams, care being taken to prevent water contamination. Food may be buried below the surface of the ground where the temperature is lower, lining a pit with burlap, and placing boards on the bottom. In addition, food containers

suspended from trees or tripods and underground ice boxes provide satisfactory means of protecting and storing food.

A suspended food container consists of a screened box that permits free circulation of air but prevents contamination by insects. The cooling effect is increased by wrapping the box in burlap which is kept damp. Fresh meat, bottled milk, and vegetables may be temporarily stored in such a container. It should not be used where the air contains any considerable amount of dust.

2. In semipermanent camps fresh or cured meats, milk, and vegetables should be kept in an underground storage room constructed similar to an old fashioned root cellar. The floor consists of well tamped earth, or boards may be used. The walls should be boarded. Ventilation is secured by windows at the ends or an outlet through the roof. Vegetables should be kept in vegetable bins, constructed of spaced slats to permit the circulation of air. The bottom should slope sufficiently to permit the older vegetables to be used first.

Canned goods should be kept in the storeroom adjacent to the kitchens. Bread boxes which permit aeration of the contents should be used.

Quality of meat can be recognized by the appearance, odor, and texture. Good meat is firm to touch, moist but not wet, and is red in color for beef, pinkish brown for veal, dark pink for mutton, and light pink for lamb and pork. Good meat has a fresh, agreeable odor.

The fat should contain no watery juices or jelly, and should be firm and white. The fat interposed between the muscle fibers gives the meat a mottled appearance.

In the field we are liable to be called upon for inspection of the freshly killed carcass. The most likely place to look for signs of disease is the chest cavity, and to a lesser extent the abdominal cavity; adhesions of the lining membrane indicate inflammation, probably tuberculosis.

When decomposition of meat is suspected trim off the tainted parts of the quarter of beef and sink a probe into the shoulder or hip joint. The odor of the probe will determine whether decomposition has set in. A whole quarter of beef should not be condemned because part of it has begun to decompose, as it is often possible to trim off the tainted portion and serve the remaining wholesome portion.

The Eber test (ammonia test) is used to detect decomposition. Place 2 cc of reagent (1 part ether, 1 part concentrated hydrochloric acid, and 3 parts absolute alcohol) into test tube and shake. A small piece of meat to be tested is lowered to within one-fourth inch of surface of reagent. If ammonia is present white ammonia chloride fumes will appear around the specimen.

Meat may be hung in cold storage but it should not be stacked in the refrigerator until it has been thoroughly chilled, preferably frozen thoroughly. When warm meat is stacked in the refrigerator decomposition develops in the center part of the stack before it can be frozen. The hind quarters and fore quarters should be stacked to permit issue alternately.

In the field a percentage of the rations is issued in tin containers, which, due to improper preparation, exposure to excessive heat, and lack of care in handling, frequently undergo decomposition and are especially dangerous to health if their use is permitted. Therefore a careful inspection of all canned goods should be required.

The terms "springers" and "swells" are applied to bulged, blown, or swelled cans. These cans, when pressure is applied at the ends give a crackling sound. "Springers" are caused by overloading the can, and though not desirable, the contents are fit for use. "Swells" are caused by the formation of gas, due to decomposition and may be differentiated from "springers" by a splashing sound when the can is shaken, and a hollow note when the can is gently tapped. These should be condemned.

Occasionally the inside of a can may present a blackened appearence—so called "can burn." This condition is not due to putrefaction, but is caused by the precipitation of stannous sulphide in an acid medium.

Formerly a can with two solder holes was indicative of a "swell" which had been punctured to let out the gas and then resoldered, but now many manufacturing firms use two solder holes in sealing their cans. It is well to reject cans with three solder holes.

Vitamins.—Vitamins are accessory food factors that occur in minute amounts in natural foods and are in varying degree essential for normal body growth and maintenance. They are complex organic compounds which the body is unable to synthesize.

Recent researches directed particularly to determining the chemical nature and synthesis of these compounds has been extensive, and present literature on this subject is voluminous. Information on their nature and physiological effects is changing progressively. Consequently the reader must refer to the latest current literature for reliable information on this subject. Due to much confusion as to terminology and the prominence this subject has attained in the popular mind it is discussed more fully than its importance as a food factor merits.

At present writing vitamins, A, B, C, D, E, and F, have been classified as accessory food factors. The following discussion is a brief and incomplete summary of present information on these vitamins:

Vitamin A.—This is a fat soluble compound obtained normally from green leafy and yellow pigmented vegetables, milk, butter, and eggs. A rich concentrate is obtained commercially from the livers of codfish and halibuts. This vitamin is commonly associated with vitamin D and these two vitamins may be administered together to advantage. Chemically it is closely related to carotene. It is moderately stable when subjected to heat. Deficiency of this vitamin causes xerophthalmia and subclinical deficiency is best determined by biophotometer test for nyctalopia. Deficiency also causes epithelial changes of the skin and mucous membranes. There is no proof that deficiency is a primary factor that increases susceptibility to infection. The average diet which includes vegetables, dairy products, and eggs, provides an ample supply of this vitamin.

Vitamin B.—This water soluble vitamin has been identified as a vitamin complex of which at least six compounds have been isolated with reasonable certainty. Early investigations that deal with vitamin B as an entity therefore present inconsistent findings. Vitamin B was classified as heat stable. However, the components of this complex vary in resistance to heat. B_2 is more stable than B_1 in this respect. Heat that renders B_3 inactive does not effect B_1.

1. *Thiamin Chloride* (B_1).—This is the antineuritic vitamin. Deficiency causes beri-beri, peripheral neuritis, gastrointestinal atony, nausea and anorexia, and altered carbohydrate metabolism. It is obtained from the following natural foods: Pericarp of cereals, wheat germ, tomatoes, eggs, yeast, prunes, and meats. It has been obtained in pure crystalline form having antineuritic activity.

2. *Riboflavin* (B_2).—The history of this vitamin is interesting and confusing. Goldberger in his researches on pellagra demonstrated that his pellagra-preventing factor differed from vitamin B and he designated it as the P–P factor. Other investigators have designated this factor as vitamin G. Therefore, vitamin B_2, P–P factor, and vitamin G are synonymous. However, vitamin B_2 and riboflavin may not be identical. Recent work indicates that vitamin B_2 may have two components (*a*) riboflavin, also called lactoflavin, and (*b*) a supplementary substance designated as B_6. Riboflavin has been obtained in pure crystalline form, identified and synthesized. In water solution it produces a yellow-green fluorescence. It is widely distributed. Recent reports indicate that it is a cell enzyme concerned with cell respiration. It is normally obtained from yeast, dairy products, eggs, leafy vegetables, and meats. Deficiency is manifested as sore mouth and dermatitis of the scrotum.

3. *Vitamin* B_3.—This vitamin occurs in whole grains, malt, yeast, and liver. Deficiency causes a loss of weight and prevents growth. It has not been identified chemically. Recent work indicates that this vitamin may have two component factors.

4. *Vitamin B_4.*—This factor has not been identified chemically. It has been found to be intimately associated but not identical with adenine. It occurs naturally in yeast, dairy products, whole wheat, liver, and lettuce. Deficiency, experimentally, causes retarded growth, muscular weakness, and incoordination, with spastic gait.

5. *Vitamin B_5.*—This is a slightly water soluble factor obtained from yeast. Like B_3 it is concerned with growth but it differs in that it permits only maintenance of weight.

6. *Vitamin B_6.*—This is the supplementary substance found associated with vitamin B_2. This factor is probably identical with or essentially similar to vitamins reported by various investigators under other alphabetical designations.

In summary, the vitamin B complex has only two components, thiamin chloride and riboflavin that need to be considered, and these occur in the foods commonly included as elements of the service ration. The other alleged components of this complex require confirmation. The special actions attributed to $B_3$and B_4 may be due to a larger supply of B_1.

Vitamin C—Cevitamic acid.—This food factor is antiscorbutic and has been definitely identified as l-cevitamic acid. The "d-form" of this acid is inactive and the "iso-form" possesses little activity. The present international unit of 1-cevitamic acid is 0.05 milligram. This is the equivalent of 0.1 cubic centimeter of lemon juice. The daily needs of this vitamin are about 250 units.

Scurvy is the typical clinical manifestation of vitamin C deficiency. The natural siurces of cevitamic acid are all citrous fruits and green vegetables including peas and spinach. It is produced synthetically. It is water soluble and easily destroyed by heat. Clendenning lists the following foods as containing more than 100 units of vitamin C per pound:

Cabbage, raw	320	Parsley	240
Grapefruit	240	Peppers	400
Lemons	240	Spinach, raw	400
Oranges	240	Strawberries	160
Tangerines	240	Tomatoes, raw and canned	240

Vitamin C differs from vitamins A, B complex, and D in that little reserve is stored in the body tissues. Hence, an adequate daily intake of this factor is particularly important. Approximately 70 percent of quantities in excess of body needs are reported to be excreted in the 3-hour period following intravenous injection.

Vitamin D.—This antirachitic vitamin promotes the deposition of calcium and phosphorus in bone formation. Consequently it is needed primarily during the years of growth. It is a product of ultra violet radiation. This antirachitic effect may be obtained by direct exposure of the body or a product having a high degree of antirachitic effect is obtained by irradiating ergosterol. The irra-

diation apparently alters the molecular structure of ergosterol. An antirachitic crystalline substance has been obtained from irradiated ergosterol.

Vitamin E.—This vitamin occurs in yeast, wheat germs, and lettuce. It promotes normal reproductive function.

Vitamin F.—This vitamin appears to be essential for the production of linoleic acid, an unsaturated fatty acid.

CONSERVATION OF FOOD VITAMINS.—Several simple but important facts must be remembered in providing troops with an adequate intake of vitamins. Personnel charged with preparing food for consumption should be familiar with these facts and conserve food vitamins. The vitamin content of foodstuffs decreases with age and exposure to heat, light, oxygen, and alkali. Since vitamins are water or fat soluble, the water or fatty liquids in which foods are preserved or cooked contain vitamins and other beneficial extractives which should be incorporated in the ration, if possible, rather than discarded as waste products. Prolonged cooking, such as is apt to occur with field kitchens, tends to destroy the vitamin content of the ration. The vegetables for stew should be cooked separately and not longer than 30 minutes; then they should be added to the meat, which requires about 2 hours of cooking. Avoid the use of alkali, e. g., sodium bicarbonate, when cooking green vegetables as this also tends to destroy the vitamins.

In Mesopotamia during the late war over 11,000 cases of disease due to food deficiency developed in 6 months—hence the practical importance of medical supervision of the field ration. British troops in Mesopotamia during the late war, eating white bread, suffered from beri-beri, while the Indian troops, eating unmilled wheat, escaped. During the seige of Kut the reverse was the case, the British lived largely on fresh meat, while the vegetarian Indians lived largely on white bread. During the late war an outbreak of scurvy occurred in the British Army among the men of the South African Labor Corps. Without the alteration of their diet, the period of cooking was reduced from 6 hours to 45 minutes, and the outbreak was immediately arrested.

The vitamin-containing foods of an exclusive military ration should weigh at least 30 percent of the total.

WATER IN THE FIELD

OFFICERS RESPONSIBLE FOR WATER SUPPLY.—The quartermaster is responsible for the procurement of water rights and for the delivery of water to the camp site. The medical officer is responsible, in an advisory capacity, for the quantity and the quality of the water at the source as well as at the ultimate point of consumption. The unit

commander is responsible for the proper distribution of the water within the organization.

WATER CONSUMPTION.—Water constitutes 60 percent of the body weight, or the equivalent of 10 gallons, which equals 100 pounds approximately in the average man's body. The loss of one gallon of this water has serious consequences; if 1½ gallons are lost, the result is fatal.

The quality and quantity of the water supply is a vital factor during field operations. In a war of movement the supply of water is very apt to be inadequate, which may mean that the consumption of water will have to be restricted to a minimum.

The minimum allowance of water for the needs of men and animals varies according to the amount of daily labor performed and also the conditions of the weather. The following may be taken as an absolute minimum: Each man, 1 gallon per day, to be used as follows—1½ quarts for drinking, 2½ quarts for cooking and drinking with meals. In combat, a soldier can maintain physical efficiency for 2 days only on one-half gallon of drinking water each day.

The above is the minimum for soldiers on the march and in bivouac. and provides no allowance for the washing of person or clothing.

In camps of more than one-night duration the following minimum allowance should be furnished:

	Gallons
In barracks	20
In camps	5–10
Drinking and cooking only	2

The daily requirements for animals are:

	Gallons
Horse	10
Mule or donkey	6

SOURCE OF WATER.—The sources of water are divided into (*a*) surface waters, such as lakes, ponds, rivers, streams, etc.; (*b*) underground waters, which include wells, springs, etc.; all these vary in degree as to purity and potability. Rain water is usually the most satisfactory of all natural waters. Large bodies of water are more likely to contain pure water than small ones, because of the greater dilution of the contaminating material. Water which is obtained from the center of a large lake is very apt to be pure, especially where the sun shines upon it.

One should always be suspicious of all surface waters as the appearance of water is no index to its purity. Water should be considered contaminated until tests prove it potable. Also, water found potable may become contaminated subsequent to test. Consequently, water used for drinking and cooking purposes should be guarded and tested frequently for contamination.

Wells are of two varieties, "deep" and "shallow." Water taken from shallow wells is always suspicious, while water taken from deep wells and deep springs is usually fit for human consumption.

1. If water from a running stream is used, it should be taken from a point where there is considerable depth, and where the current is strong, always upstream, or in other words, above the camp site. Upon arrival in camp, a guard should be posted over the water supply and the stream should be inspected and marked for use. Beginning upstream the water should be assigned for use as follows: (*a*) Drinking and cooking water. (*b*) Water for animals. (*c*) Water for bathing. (*d*) Water for laundry purposes.

To compute the volume of water of a flowing stream the following may be used as a guide: Sectional area in square feet, multiplied by 0.8 velocity in feet per minute, multiplied by 7.48, equals gallons per minute.

2. Rain water, though not very palatable, is the safest and purest of waters. In warm countries it may be necessary to use it for drinking purposes but it must be properly collected and stored. Rain water is easily collected from the roofs of houses or other prepared surfaces. These surfaces must be kept free from pollution, such as excrement of birds, dust, decayed leaves, etc. The first washing of the rain should never be used as it will probably contain some pollution from the roof. In storing the rain water, the containers should be well covered and ventilated, and frequently cleaned to prevent pollution. One inch of rainfall produces 22,500 gallons of water per acre. The number of gallons of rain water expected to be recovered from a roof may be determined by the following formula: *Area of roof in square feet, multiplied by one-half the rainfall in inches, equals number of gallons.*

3. Well water usually comes from two sources. The greater portion filters in from the deeper strata of the soil and may be considered as free from contamination. However, wells are rarely properly encased near the surface and properly covered as protection against surface water drainage and other pollution. Therefore all wells should be regarded as contaminated and should be cleaned and disinfected prior to use by employing the following measures:

(*a*) Remove all refuse from well.
(*b*) Pour into well about half-barrel of a solution of freshly burned lime (or a 1 percent solution of chlorinated lime can be used).
(*c*) Scrub sides of well with above solution.
(*d*) Wait 2 hours, pump well dry, and repeat above procedure.
(*e*) Wait 24 hours, pump out well, allow to refill.

(*f*) Continue to pump out until all taste of lime has disappeared.

(*g*) Sterilize water in well by adding a solution of chlorinated lime—30 grains to every 100 gallons of water in well.

(*h*) To compute number of gallons in well use formula: *The square of diameter of well in feet multiplied by 0.7854, multiplied by depth of well in feet multiplied by 6.25 equals gallons in well.*

Transportation and storage.—Water carts employed in the transportation of water should be subjected to the following sanitary measures:

(*a*) The tank of water cart should be scrubbed out every 4 days with a 1 percent solution of chlorinated lime.

(*b*) Water carts should never be devoted to other purposes than to provide drinking water for men.

(*c*) A half-teaspoonful of chlorinated lime—30 grains—well dissolved as a paste, added to 100 gallons of water will produce approximately 1 part per million of free chlorine, and is sufficient to sterilize this quantity of water.

The best storage containers are those made of concrete, slate, or galvanized iron. Wooden containers will, after a time, give the water a very disagreeable taste. Water receptacles should be well covered. As the ground in close proximity to a water faucet is likely to be wetted, it is best to build a sand or gravel pit, 2 feet square and 1 foot deep, to absorb the waste water.

The receptacles should be cleaned daily with boiling water, or rinsed with a solution of potassium permanganate (one-third teaspoonful to 1 gallon of water). A solution of chloride of lime is also very good for this purpose, in proportion of 1 to 1,000. These solutions are harmless and more certain in their action than boiling water used alone.

Canteens, when not in use, should be emptied, dried, and cleaned, with one of the above solutions. Weak tea has been highly recommended for drinking purposes in canteens; it should be boiling hot when poured in, thus insuring the sterility of the canteen as well as of the contents.

Common drinking cups should not be used; however, if individual drinking cups cannot be supplied, lip drinking should be practiced. Should conditions arise which make it absolutely necessary to use common drinking cups, a certain degree of safety can be insured by keeping the cup immersed in a solution of formalin (1 percent).

Data regarding water.—The maximum density of water is at 4° C., which explains the fact that ice is lighter than water. One milliliter of water at 4° C. weighs 1 gram. Water when frozen liberates

80 Calories of latent heat, and expands 9 percent in bulk; the latter fact explains the bursting of water pipes in winter.

The addition of salt to water raises the boiling point and lowers the freezing point.

One cubic foot of water equals 7.48 gallons.
One gallon of water equals 10 pounds, or 70,000 grains.
One liter of water equals 0.26418 gallon.

WATER PURIFICATION

PURIFICATION OF TEMPORARY WATER SUPPLIES. GENERAL.—The water supply for moving troops, for temporary camps and installations, or for troops in the theater of operations frequently must be purified under conditions which do not permit the installation of permanent or semipermanent water purification works. The agencies employed generally for this purpose are: (1) Chemical. (2) Heat. (3) Filtration.

CHEMICAL PURIFICATION.—Chlorination is extensively practiced today. Hypochlorite of calcium, commonly called bleaching powder, is the substance used, and is issued by the quartermaster in small glass tubes.

The ordinary calcium hypochlorite (Calx Chlorinata) or bleaching powder contains 33⅓ percent of available chlorine when freshly prepared, but is an unstable substance, so that the supply received may contain but little chlorine. There are hypochlorites available, however, and now recommended for use, which contain well above 60 percent available chlorine, are very stable and easily miscible. Bleaching powder tends to form small, hard lumps when placed in water. In preparing a hypochlorite solution just sufficient water should be added to the powder to permit the easy formation of a smooth thin paste, which is then diluted as required and placed in the chlorinator. Twenty-five pounds of ordinary bleaching powder added to 1,000,000 gallons of water give one part per million of chlorine. If 4,000 gallons of water are to be chlorinated one-tenth pound of hypochlorite is sufficient. A drip chlorinator may be used in a small stream, the size of the containers and the strength of the solution being determined by the rate of flow of the stream, however the drip chlorinator is not recommended. In case water is so turbid as to make it unsatisfactory for use, it may be clarified by allowing it to stand for some time in a reservoir and clarification may be hastened by the addition of chemicals. Alum, lime, and soda ash are used for this purpose.

CHLORINATING WATER FOR SMALL DETACHMENTS.—Small detachments separated from the main body of troops and its pure water supply may be provided with safe water by chlorination of canteen water.

The contents of one tube of calcium hypochlorite is dissolved in 1 quart of water and preserved in a glass bottle. A metal container is not used as the concentrated calcium hypochlorite has a chemical action on the metal. One teaspoonful of this solution added to 1 canteen of water and allowed to stand for 30 minutes renders the water safe for drinking. If the tubes are not available, then dissolve 1 teaspoonful of chlorinated lime, taken from a freshly opened container, in 1 quart of water and label this "stock solution." This solution deteriorates very rapidly and fresh solution should be prepared every fourth day. One teaspoonful of this stock solution added to each gallon of water and allowed to settle for 30 minutes will insure the destruction of most bacteria.

Sterilizing water by iodinization.—Two and one-half teaspoonfuls (10 cc) of 7 percent tincture of iodine added to a sterilizing bag of water will purify it in 30 minutes. Two drops of the tincture added to one canteen of water and allowed to stand for 30 minutes will render it pure.

There are two objections to this method of sterilization:

1. There is no reliable method for titrating the iodine in a test for sufficiency of the amount added.
2. This method is more expensive than the hypochlorite method. (The excess of iodine may be neutralized by adding 1 gram of sodium thiosulphate.)

Water sterilizing bag.—The water sterilizing bag, often called the Lyster bag, is made of specially woven, waterproof canvas, weighing about 7 pounds, and can be folded into a compact package. It measures 20 inches in diameter and 28 inches in length, holding about 36 gallons. Its sole use is as a stationary receptacle for water while being sterilized and distribution of same after sterilization, without dipping. This is accomplished by faucets which are arranged around the bottom of the bag. The Lyster bag is part of the Marine Corps field equipment and is issued on the basis of 1 bag for each 100 men or fraction thereof. (See fig. 1.)

To use, this bag is suspended from a tripod and filled with water. To each bag of water (36 gallons) there is added the contents of one ampule of calcium hypochlorite. The calcium hypochlorite is issued in sealed glass tubes, one tube sufficing for one bag of water. The water is then allowed to stand for at least 30 minutes before using, as the sterilizing process is one of oxidation, and is not complete in less time. In water that contains much suspended matter, or is very cloudy, the sterilizing action is not very satisfactory so that it is necessary to clarify the water before chlorination which may be accomplished by means of a small filter cloth provided with the bag.

1. Arrange bag on tripod. Strain water and fill bag to within about 4 inches of the top.

2. Procure a clean stick, or cut a limb from a tree for use in stirring of water. Place this in water and leave there during sterilization.

3. Break one of the glass ampules of calcium hypochlorite and shake the powder into a cup. Mix with water until a fine paste results, and then stir with a spoon, adding more water until the paste is entirely dissolved.

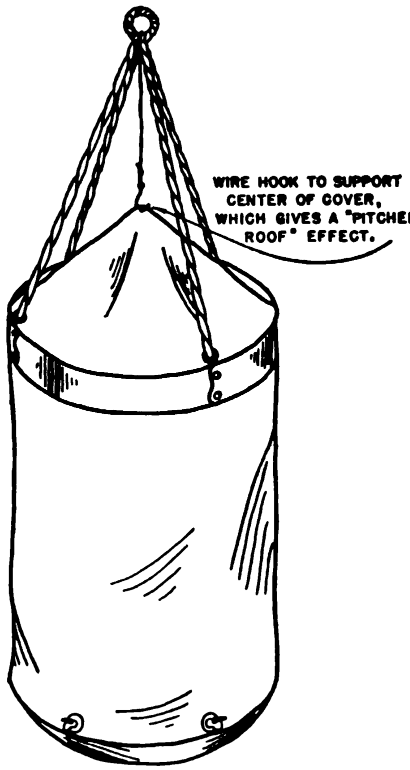

FIGURE 1.—Water bag. (Diagram prepared by Lieut. (jg) James B. Butler, Medical Corps, U. S. Navy.

4. Add the hypochlorite solution to the contents of the bag and mix thoroughly with the stick provided for that purpose. Draw 3 cupfuls through each of the faucets (to clean and sterilize) and pour back into the bag.

5. Draw off 1 cup of water and add to it the contents of one ampule of orthotolidine, stirring with a clean, dry spoon. As the water is stirred it turns yellow, the degree depending on the amount of hypochlorite present. An orange or orange red color indicates a sufficient amount for sterilization. A canary yellow color indicates an insufficient amount and hypochlorite should be added to the bag one tube at a time until the right color is obtained. The water is then allowed to stand for 30 minutes and guarded to prevent use during this period.

6. Excess chlorine gives the water an unpleasant taste. This can be dispelled by neutralization with sodium thiosulphate. Sodium thiosulphate is provided in glass ampules. The contents of one ampule should be added to a cup of water, stirred until dissolved, and after sterilization of the contents of the bag is complete, should be poured into it.

7. The faucets should then be rewashed for the last time, running at least 5 cups of water through each faucet and returning the water to the bag. This treatment renders the water perfectly safe, even though it was previously heavily contaminated.

8. Unless precautions are taken men will drink directly from the faucets. They should be required to use their individual mess-kit cups.

9. The bag cover may be supported in the center by means of a wire to the apex of the tripod support. This gives a pitched roof effect, allows rain water to run off the top and prevents sagging of the top and contamination of the contents.

MOBILE WATER PURIFICATION UNIT.—The United States Marine Corps has procured two highly efficient mobile purification units, and has placed one on each coast. Essentially the unit consists of the following:

1. Gasoline engine driven centrifugal pump.
2. Pressure filter.
3. Chlorinator.
4. Soda ash feeding device.
5. Suction hose and discharge hose.

The above is mounted on a circle steer highway trailer.

The pump has the following capacities:

1. Twenty-five gallons per minute against a 10-foot delivery head through filter.
2. When filtration equipment is bypassed—in case the raw water is sufficiently clear—the pumping equipment and solution feed chlorinator will deliver 50 gallons per minute of sterilized water against a 50-foot head.
3. When filtration and purification equipment is bypassed, and the unit used as a pumping device, then 100 gallons of water per minute can be delivered against a 75-foot head.

Thus the mobile unit may be operated as:

1. A simple pumping unit.
2. A pumping and chlorinating unit.
3. A pumping and filter unit, with or without chlorinator.

It is rather spectacular to watch the operation of one of these units with the suction hose placed in a muddy contaminated pond of water deliver a clear purified stream of potable water, at the rate of a barrelful each minute, at the discharge hose.

BOILING.—Boiling is a simple and effective method of water sterilization and may be used in the presence of an epidemic of intestinal disease, such as dysentery or cholera, and when materials are lacking for sterilization by other methods. Boiling was used effectively by the Japanese in the Russo-Japanese War in controlling water-borne diseases.

However, boiling all drinking water entails a considerable amount of fuel and time. For 250 men nearly three barrels of drinking water are required each day and it would be a heavy task upon the rolling kitchen if the boiling is to be done there.

Boiled water has a flat taste unless it is aerated after cooling. Its taste may be improved by the addition of tea or coffee.

Each man can boil water in his canteen, by placing the canteen full of water in a fire, or upon hot coals until the water boils, after which it is removed and allowed to cool. Troops can, after a day's march, prepare their canteens full of boiled water for use on the next day.

FIELD FILTERS.—The barrel filter consists of a small barrel inserted into one of larger dimensions and separated from the bottom of the larger barrel by about 3 inches of fine sand. The smaller barrel having a perforated bottom, is placed upon the sand in the larger barrel; then more sand is placed around the small barrel to the height of about 6 inches. A layer of charcoal and a layer of gravel may be placed above the sand.

The barrel filter may be sunk into a lake or spring; water may also be filtered by pouring it into the larger barrel.

In connection with drinking water, special attention should be given the following:

1. Regard all water in the field as contaminated unless proved otherwise.
2. Do not let the men fill their canteens from any unauthorized source.
3. Place a guard at the source of the water supply to prevent its pollution.
4. Water discipline on the march should be rigidly enforced.
5. Remember that not only the quality of the water supply but also its quantity should be supervised by the medical officer.
6. The amount of water lost by evaporation, and otherwise, by a man marching for 1 hour, or 3 miles, is nearly 1 pint.
7. The results obtained by modern military organizations demonstrate that water-borne diseases are preventable.
8. The prevalence of a water-borne disease in a camp indicates a weak link in the chain of sanitary measures.

SUMMARY

POINTS TO BE COVERED AND REPORTED ON IN A WATER RECONNAISSANCE[8]

1. LOCATION.—Sources and works should be shown on a map, or their location given by description.

[8] From Pamphlet No. 3, Medical Field Service School, U. S. Army.

2. CHARACTER OF SOURCES.—Well, spring, stream, lake, or pond.
3. QUANTITY OF WATER AVAILABLE.—
   Rate of flow of streams.
   Rate of flow and capacity of wells.
   Rate of flow of springs.
   Dimensions and estimated depth of lake or pond and, if indicated, rate of inflow and outflow.
4. QUALITY OF WATER.—
   Turbidity.
   Color.
   Taste.
   Result of bacteriological examination, if indicated, and if it is practicable to secure samples and have them analyzed.
5. SOURCES OF BACTERIAL CONTAMINATION.—
   Character of sources.
   Location in relation to water supply.
   Control measures indicated.
6. ACCESSIBILITY.—
   Accessibility of sources of water to troops by railroad, highway, improvised roads, trails, or hand carry.
7. WELLS.—
   Diameter.
   Depth of well.
   Depth of water.
   Distance from surface of the ground to surface of the water.
   Type, condition, and depth of casing or lining.
   Kind of soil.
   Nature of impervious strata, if indicated, and ascertainable.
   Method of recovering water, i. e., pump, windlass, etc.
8. SPRINGS.—
   Kind of spring.
   Protection provided, i. e., coping, watertight basin, ditching, etc.
9. STREAM.—
   Mean velocity.
   Mean width.
   Mean and maximum depth.
   Nature of bed.
   Height of banks above surface of water.
   Method of recovering the water provided.
10. EXISTING INSTALLATIONS.—
   Purification facilities—chlorinating apparatus, filters, etc.
   Pumps—number, size, type, speed, and capacity.

Engines—type, size, speed, and horsepower.
Electrical equipment.
Storage facilities—type and capacity.
Pipe lines—length, size, and material.
Present condition (description).

11. Proposed developments.—
Description.
Material available.
Material required.
Time required.

FIELD CONSERVANCY

"Field Conservancy" is a technical term employed to designate the disposal of waste products in the field.

The disposal of waste products is one of the most important field sanitary measures, and the importance of proper waste disposal was known to the ancients.

Burial was the earliest means of disposal and is instinctive in many of the lower animals, since animals such as dogs and cats bury their dejecta. Moses—from his experience with a plague of flies in Egypt—in his advice to the Israelites, in Deuteronomy xxii, 12–14, lays down the sanitary directions, "Thou shalt have a place also without the camp, whither thou shalt go forth abroad, and thou shalt have a paddle upon thy weapon; and it shall be, when thou wilt ease thyself abroad, thou shalt dig therewith and shall turn back and cover that which cometh from thee."

Suppose that no precautions were taken to accomplish sanitary disposal of waste products in the field, then the danger of the spread of contagious diseases in an army would be in direct ratio to the size and density of the aggregation. Thus when an army takes the field the danger from epidemics would increase with the square of the number of men. In other words, under conditions in which the measures of preventive medicine were not employed, the possibility of an individual soldier acquiring an infectious disease in an army of 1,000,000 men would be approximately one thousand times greater than in a regiment of 1,000 men acting independently. Various other factors enter into consideration that tend to render these statements not mathematically exact; however, they are sufficiently accurate for purpose of illustration.

Field sanitary measures of modern military preventive medicine has reached a stage in development in which it is now possible to assemble a million men in the field and prevent decimation from

epidemics. It is interesting to note that this achievement has been consummated only in comparatively recent years. As an example of this compare the ratio of death rate in battle to the mortality rate from diseases during the Civil War (1 to 2) to the ratio existing in the World War (1 to 0.06).

Waste products may be divided as follows:

1. Refuse:
   (*a*) Garbage.
   (*b*) Rubbish (boxes, paper, etc.)
2. Excreta:
   (*a*) Night soil (urine and feces).
   (*b*) Manure (stable litter).

Or they may be classified as follows:

1. Solids:
   (*a*) Human feces.
   (*b*) Kitchen garbage.
   (*c*) General camp rubbish.
   (*d*) Stable refuse.
2. Liquids:
   (*a*) Urine.
   (*b*) Kitchen sullage.
   (*c*) Ablution water.

The proper disposal of waste constitutes one of the most important functions of the field sanitarian.

In the disposal of waste the following objectives are involved:

1. *Prevention of insect breeding.*—To change the nature or location of waste matter so that fly breeding will be prevented, and also the breeding of other disease-carrying insects.

2. *Destruction of microorganisms.*—To destroy or otherwise eliminate the presence of organisms which may cause disease.

3. *Removal of a nuisance.*—Waste matter and filth are almost synonymous terms; and, as such, the accumulation of waste creates a condition which is offensive to the senses of sight and smell.

The methods for ultimate disposal of waste products can be grouped into two main procedures, namely—

1. Burying:
   (*a*) Shallow—Temporary camps.
   (*b*) Deep—Semipermanent camps.
2. Burning—Permanent camps.

In camps not of a permanent nature and with moving troops, burial is a more convenient and rapid means of waste disposal and is uni-

versally practiced in our modern armies. Incineration has the advantage of complete destruction of all waste and is the better method, from a sanitary standpoint, for permanent camps.

COLLECTION AND DISPOSAL OF REFUSE.—Metal garbage cans, if available, should be placed at intervals in the company streets for the deposit of waste paper, burnt matches, cigarette stumps, fruit peelings, etc. The use of receptacles of this sort accomplishes primary cleanliness of the camp and inculcates the habit of cleanliness in the men. If metal receptacles are not available, wooden or cardboard boxes may be employed.

Garbage cans should be well covered and placed on raised platforms at least 2 feet from the ground. The soil beneath these platforms is easily contaminated by the overflow of drippings, and requires careful supervision to prevent pollution and fly breeding. The surface beneath garbage cans should be scraped daily and shoveled into the garbage cans. Fresh dry earth should be spread over the scraped area. The promiscuous use of lime to cover filth is not recommended.

SHALLOW BURIAL.—The surface of the earth usually consists of bacterial soil varying from a few inches to a few feet in depth. The top layer of the earth's surface is inhabited by millions of friendly germs—the germs of decomposition—which break up organic matter into various gases and water, and so rid the earth of the debris which would accumulate on the surface. It is part of the scheme of nature that it must be so, for if constant breaking up of organic matters were not going on, the surface of the earth would become choked and we should find ourselves up to the middle in leaves, which fall and accumulate.

The surface of the earth is always assisting in this destruction of organic matter. This layer of germ-charged earth is known as the live humus or living filter, because the germs not only destroy organic matter, but they prevent the passage of filth into the soil. The live humus varies in depth according to the nature of the soil, and is deepest where the soil is very light and where air can percolate through the surface. In this case it may reach to a depth of 2 or 3 feet. Usually, the depth of this humus-bearing soil is 1 to 1½ feet. Below the level of the live humus the earth is sterile or free from germs, and, if buried deep, organic matter such as excreta receives no assistance from the earth in the matter of decomposition. The live humus varies in its intensity from time to time, for if the germs are well fed they increase and multiply, whereas if they are starved they perish.

Germs require food, moisture, and warmth for their growth, and if well supplied with these they will multiply in proportion to the amount of food they obtain. Thus the live humus varies in intensity

according to the time of year, for in a very dry summer, when the surface of the earth becomes bone-dry, decomposition may be absolutely arrested, and a body may become mummified or sun dried if it is covered with sand to keep off flies. (Moss-Blundell.)

LATRINES

THE ALLAHABAD SYSTEM.—Nitrification of excrement in the soil is the sole aim of sanitary science, and the more intimately the excrement is mixed with the dry earth the quicker will nitrification occur.

The germs which cause nitrification are in the upper few inches of the soil and this fact is taken advantage of in the disposal of excreta by the so-called Allahabad system, as used in India.

An area 16 feet long and 5 feet wide is excavated to the depth of 3 inches. The excavated soil is placed at one end. The denuded area is then loosened to a depth of nine inches. The area is sufficient to dispose of sixty gallons of night soil, when dumped in the center. The liquid waste is absorbed by the loosened soil. The solid matter is spread over the area, and then covered with the 3 inches of soil previously removed. This is tamped down.

In a few weeks, depending on the temperature, the solid matter is completely decomposed and all pathogenic germs are destroyed.

The Allahabad method is useful in permanent campsites—using the bucket system—where fuel is limited for incineration, but under the usual field conditions this method is of more academic interest than practical value.

SHALLOW LATRINES.—On the march: A marching column is supposed to rest for 10 minutes every hour on the march, and during the rest period the medical officer should see that some place is provided for the men to relieve themselves. As soon as the column halts, a sanitary detail from the company should immediately proceed to improvise latrines. A few narrow trenches about 8 inches deep and 1 foot wide will suffice, and can be hastily constructed with a sharp stick, spade, or bayonet. The sanitary detail should remain to fill in the latrines with earth when the march is again resumed.

In temporary camps: Camps which are to be occupied for 15 days or less should be provided with "straddle trench" latrines with dimensions as follows: 1 foot wide, 2 feet or less deep, 3 feet long. The straddle trenches are also called the "One-two-three" latrines because of their dimensions.

These shallow trenches are more effective in disintegrating solid waste than the deep trenches, as the germs of nitrification are found only in upper few inches of the soil. All excretion and disease producing organisms, even the toilet paper, disappear in these shallow trenches in 4–5 weeks, as one investigator reports.

Straddle-trench latrines should be constructed parallel to each other and should be 3 feet apart; the loose earth should be heaped close to one end of the trench. A shovel, spade, tin, or other similar articles should be on hand, and each man should be required to cover his dejecta with loose earth after defecation. Often it is necessary to establish a guard in the sanitary area to prevent this weak link in the chain of sanitation. The straddle trench latrine may be designated the open shallow latrine.

Deep latrines.—The open deep latrines, similar to those used during the Spanish-American War, and which created such insanitary conditions and contributed to the spread of typhoid fever, will be omitted from discussion, for quite obvious reasons.

In semipermanent and permanent camps, deep covered latrines are recommended.

These latrines require more time and labor to construct than the shallow-trench latrines, but have the advantage that they are easier to make fly proof.

The dimensions for deep latrines vary considerably, but the following may be taken as a standard: 2 feet wide, 6 feet deep, 7½ feet long.

In loose soil it may be necessary to revet the latrine pit.

The Army latrine box is an excellent type of cover for deep latrines. The exact specifications for building this box will be found in one of the diagrams in this chapter. The box consists essentially of an inverted open box built to a convenient height above the ground, containing pear shaped holes in the top, with lids covering these holes. The lids are made to open not over 85°, which will cause them to close automatically. A space of one-fourth inch should be left at the seat hinge to allow for the swelling of the wood. (See fig. 2.)

These deep latrines are usually intended for use over a long period of time. Most of the odors of latrines are due to ammoniacal and other decomposition of urine and the separator system is sometimes used to separate the urine from the feces. A urinal soakage pit is built close by, and by means of a tin gutter, built in front of and under the seat, the urine accompanying defecation is drained into the soakage pit. A urinal trough connected to a soakage pit should be constructed within the latrine enclosure.

The latrine is improved by erecting it on a mound a foot high composed of earth removed from pit. This mounding of earth prevents surface drainage into pit causing contents to overflow. Latrines should be abandoned when filled to 1 foot from normal surface level. They should be liberally sprayed with crude oil or

covered with quick lime and mounted with earth. Each abandoned latrine should be labeled with a small wooden sign. When dug in wet soil a foot or two of water often appears in the bottom of the pit. Such water aids in absorption of the contents into surrounding soil and many such latrines exhibit septic action.

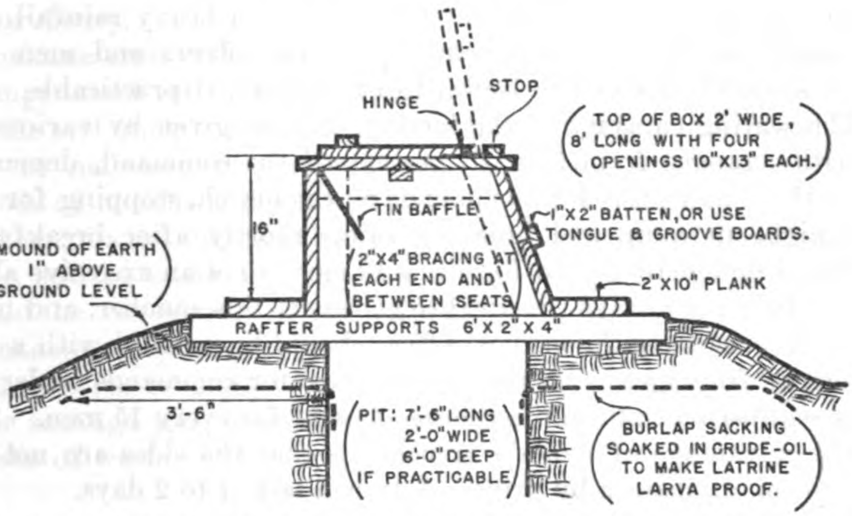

FIGURE 2.—Modification of standard U S Army latrine box. Diagram prepared by Lieut. (jg) James B. Butler, Medical Corps, U. S. Navy.

Bill of materials

	1 box and enclosure	2 boxes and enclosures
Top of box	2 pieces 1″ by 12″ by 8′—0″	4 pieces 1″ by 12″ by 8′—0″.
Front of box	2 pieces 1″ by 8″ by 8″—0″	4 pieces 1″ by 8″ by 8′—0″.
Rear of box	2 pieces 1″ by 10″ by 8′—0″	4 pieces 1″ by 10″ by 8′—0″.
Ends of box	1 piece 1″ by 8″ by 8′—0″	2 pieces 1″ by 8″ by 8′—0″.
Seat covers	1 piece 1″ by 12″ by 7′—0″	2 pieces 1″ by 12″ by 7′—0″.
Do	1 piece 1″ by 2″ by 7′—0″	2 pieces 1″ by 2″ by 7′—0″.
Battens and strips [1]	8 pieces 1″ by 2″ by 8′—0″	16 pieces 1″ by 2″ by 8′—0″.
Frame for box	1 piece 2″ by 2″ by 4′—6″	2 pieces 2″ by 2″ by 4′—6″.
Do	2 pieces 2″ by 4″ by 9′—0″	4 pieces 2″ by 4″ by 9′—0″.
Front plank under box	1 piece 2″ by 10″ by 8′—0″	2 pieces 2″ by 10″ by 8′—0″.
Rear plank under box	1 piece 2″ by 6″ by 8′—0″	2 pieces 2″ by 6″ by 8′—0″.
End plank	1 piece 2″ by 6″ by 3′—0″	2 pieces 2″ by 6″ by 3′—0″.
Do	1 piece 2″ by 12″ by 3′—6″	2 pieces 2″ by 12″ by 3′—6″.
End strip	1 piece 1″ by 6″ by 2′—9″	2 pieces 1″ by 6″ by 2′—9″.
Posts	10 pieces 10′—0″	12 pieces 12′—0″.
Boarding [2]	48 pieces 1″ by 12″ by 6′—0″	66 pieces 1″ by 12″ by 6′—0″.
Battens	48 pieces 1″ by 2″ by 6′—0″	66 pieces 1″ by 12″ by 6′—0″.
Paper	2 rolls	3 rolls.
Stringer—if roof is used	1 piece 2″ by 6″ by 14′—0″	1 piece 2″ by 6″ by 12′—0″.
Do	2 pieces 2″ by 4″ by 14′—0″	2 pieces 2″ by 4″ by 8′—6″.
Rails	8 pieces 2″ by 4″ by 12′—0″	2 pieces 2″ by 4″ by 8′—6″.
Nails	3 pounds twentypenny	4 pounds twentypenny.
Do	8 pounds tenpenny	12 pounds tenpenny.
Do	4 pounds eightpenny	9 pounds eightpenny.
Strap hinges	4 pair 4-inch	8 pair 4-inch.
Flat-head screws	4 dozen No. 8	4 dozen No. 8.
Galvanized-iron urinal trough	1 piece 6″ by 6″ by 3′—0″	1 piece 6″ by 6″ by 3′—0″.
Wrought-iron pipe	1 piece 1″ by 1¼″ by 1′—4″	1 piece 1″ by 1¼″ by 1′—4″.
Wrought-iron pipe bent as shown	1 piece 1″ by 1¼″ by 4′—0″	1 piece 1″ by 1¼″ by 4′—0″.
I. C. tin	1 sheet 20″ by 28″	2 sheets 20″ by 28″.
Labor—Carpenter	20 hours	32 hours.

[1] If T and G material is used omit battens.
[2] 1-inch boards or equivalent in other widths if boarding is used.

SITE AND NUMBER OF LATRINES.—Latrines should (*a*) be constructed at least 100 feet from the camp. Deep closed latrines may be constructed at a distance of 50 feet. (*b*) They should be constructed on the side of the camp opposite to the galley and kitchen, and (*c*) if practicable, located so as to drain away from the water supply. (*d*) They should be placed at a safe distance from ditches and gulleys to avoid the overflow which might be caused by a heavy rainfall. (*e*) Separate latrines should be constructed for officers and men. (*f*) They should be located to leeward of the comp, if practicable.

The seating capacity of the latrine area, as given by various authorities, ranges from 5 to 15 percent of the command, depending upon the conditions. For commands on the march, stopping for only one night in camp and breaking camp shortly after breakfast, a latrine frontage of 1 yard for every 10 men is not an excessive allowance. It is not always practical to construct this number, and under such circumstances the medical officer should be satisfied with a 6- to 8-percent frontage, using the latter figure for commands under 500. In a semipermanent camp estimate one seat for every 15 men.

The advantage of straddle-trenches is that the sides are not subject to contamination by urine. A trench lasts 1 to 2 days.

For straddle-trenches the frontages required in yards is six times the complement in hundreds—that is, 200 men will need 12 yards of latrine frontage. The depth in yards is two-thirds the number of days stay in that camp.

CARE OF LATRINES.—When deep latrines are filled to within 1 foot of the surface with excreta, they should be filled in with earth and abandoned. The filled-in latrines should be covered with a mound of earth and labeled with an "L" if practicable. This marking of the abandoned latrines serves to inform future occupants of their site.

The inside of deep trench latrines should be darkened by the use of tar paper, lampblack, or other suitable material. The use of a dark substance will prevent the entrance of ova-depositing flies. This depends upon the principle that flies usually avoid dark places.

The box cover may be removed occasionally and the inside burned out with kerosene or crude oil.

In order to prevent the egress of any fly larvae which may develop in the depth of the latrine and burrow through the ground around the mouth of the pit, an area of about 4 feet around the pit should be covered with crude oil, or a 5-percent solution of cresol. A better method is to cover the area with burlap sacking soaked with crude oil.

It is very desirable that some provision be made for the men, especially cooks and other food handlers, to wash their hands

after using the latrines. Sufficient toilet paper should always be available.

In order to prevent the possible flooding of latrines by storm water, a shallow trench should be dug around the area occupied by the latrine.

Latrines should be surrounded by a canvas screen or a screen made of shrubbery.

Soakage pits.—Soakage pits are one of the greatest developments in improvised sanitary appliances. The writer has installed them in cells and other compartments of a tropical prison and found them easy to maintain in comparatively good sanitary condition over periods of months and years.

These pits are designed for the ultimate disposal of liquid wastes, urine, sullage water and ablution water. These sanitary expedients should be considered in the establishment of semipermanent and permanent camps.

Ant heaps, or nests of other termites have been used as ready-made soakage pits, and have been found capable of absorbing 300 gallons of waste in 24 hours.

Soakage Pits and Grease Traps

Urinal soakage pits.—(*a*) Dig a pit 4 feet square—easily remembered—fill to within 6 inches from surface with large stones, or empty perforated cans.

(*b*) Insert 4 pieces of iron piping, 1 to 2 inches in diameter, and 4½ feet long at each corner of the pit, so that the upper end is at a convenient height above the ground to serve as a urinal. If iron piping is not available, long tin or tar-paper funnels may be improvised for this purpose.

(*c*) Cover stones with oil-soaked burlap sacking, tar paper, or other material.

(*d*) Fill over burlap with earth.

(*e*) Insert replaceable tin funnels in iron piping—preferably with screening over apex of funnel to catch cigarette butts and other debris.

(*f*) Surround urinal pit with white-washed stones—to render more visible at night.

(*g*) A vent leading into the pit may be constructed to give exit to the gases of fermentation and putrefaction.

(*h*) In porous soil, one urinal soakage pit will dispose of urine of 100 to 200 men for an indefinite period. (See fig. 3.)

Night urinals.—If the urinals are located some distance from the camp, it is a temptation to a man desiring to evacuate his bladder,

particularly on a cold night, to urinate upon the adjoining tent, and so on down the company street. To overcome this tendency, urinal cans should be placed in the company streets at night, with a lighted

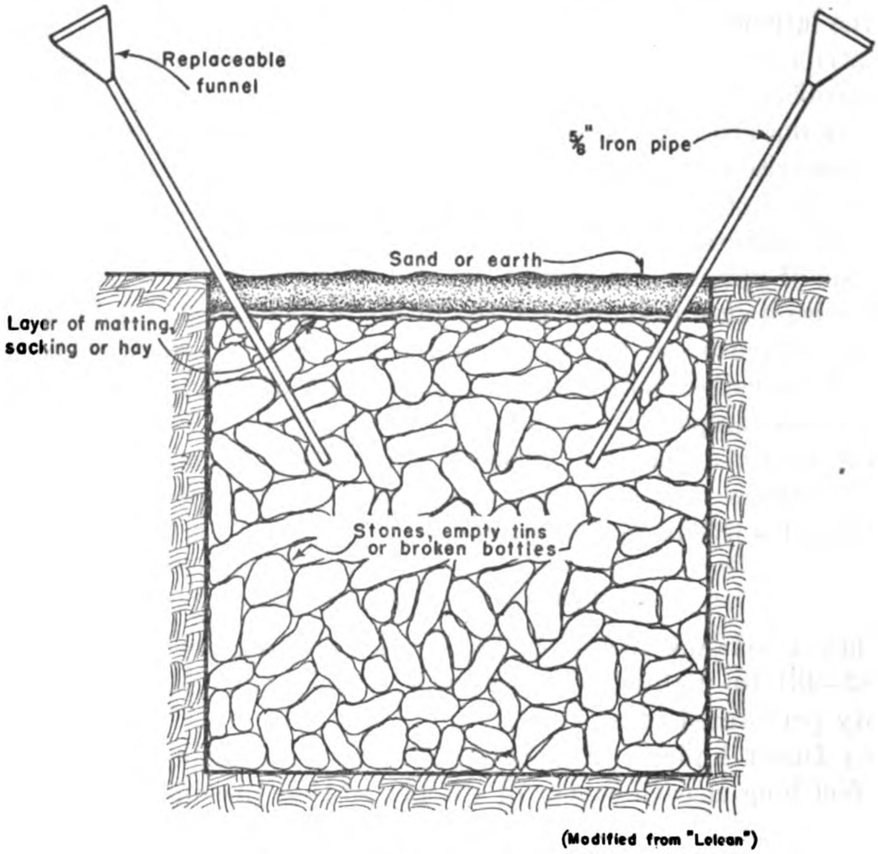

FIGURE 3.—Urine soakinge pit.

lantern to mark the location. The cans used for urinals should be cleaned and sunned during the day. Figure 4 represents a simple and easily constructed night urinal, which we found most helpful in the early days at Quantico. An ordinary garbage can top is perforated at the center, and a urinal trough is secured by solder. Placing this converted top upon the regulation garbage can makes a very satisfactory night urinal. Or a more simple type of night urinal can be improvised by making a hole in center of top of garbage container and placing the inverted top over the garbage can.

SULLAGE PITS.—The sullage pit is for the disposal of water from kitchen garbage. These pits are 4 by 4 by 4 feet. They should be fitted with grease traps to remove the grease which tends to clog the interstices of the soakage pit.

In very temporary camps, sand and gravel placed in a can or bucket with perforated holes at bottom will serve to remove the major portion of the grease.

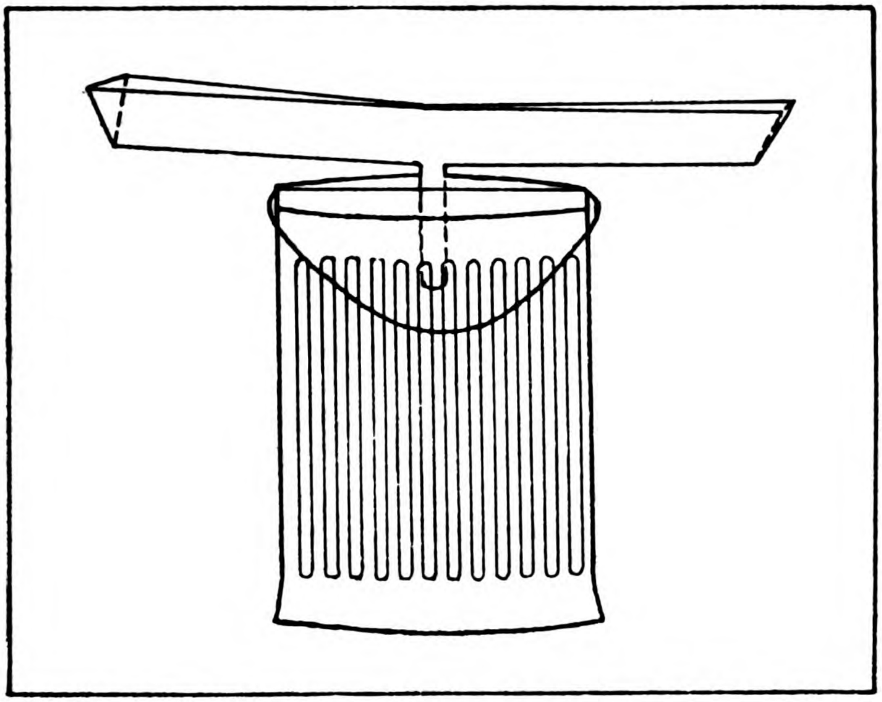

FIGURE 4.—Night urinal.

The improvised bucket grease trap may be placed over the open soakage pit filled with stones.

ABLUTION PITS.—If the ablution water is run through a box of fine sand, before entering the soakage pit, the major portion of the soap is removed.

See Figure 5 for a combined soap and grease trap.

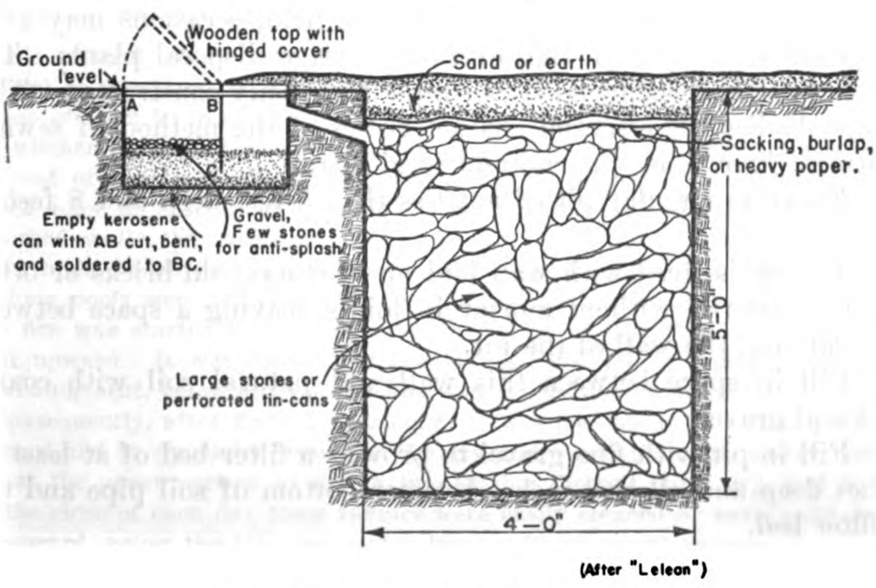

FIGURE 5.—Waste water and grease trap.

ASH BARREL GREASE TRAP.—An ash barrel grease trap is prepared by using a barrel of about 50 gallons capacity and with one head removed, and boring 30 one-inch holes in the remaining head. Place about 8 inches of gravel or stone in the bottom, the size of the stones decreasing from 1 inch at the bottom to ¼ inch at the top, and over this place 16 inches of wood ashes. Fasten a piece of burlap over the open top of the barrel by means of a hoop. The trap may be placed directly on the soakage pit or on an impervious platform which drains into the pit.

The sullage water is poured into the barrel through the burlap, food particles thus being strained out. As the greasy, soapy water filters through the ashes the greater part of the grease and soap will be removed. The burlap should be removed daily and burned, and it will be necessary to replace the ashes every 3 or 4 days.

When more than 200 gallons of water per day are to be disposed of, additional soakage pits and grease traps may be necessary.

WASTE DISPOSAL

DISPOSAL OF GARBAGE TO FARMERS.—It is sometimes possible to dispose of the kitchen refuse by contract with the farmers in the vicinity to haul it away to use as food for hogs, poultry, etc. This method of removal is satisfactory at times, but at other times it will be found difficult to induce the farmers to remove the garbage at regular intervals, thus allowing the waste to accumulate and become a nuisance. Under these circumstances it is frequently advisable to resort to other means of disposal and to burn or bury the kitchen garbage together with the other waste products.

SMALL SEWAGE DISPOSAL PLANT.—In the field, occasions may arise that require the construction of small sewage disposal plants. The "filter type" is recommended as simple and easily constructed. This type embodies the essential characteristics of the method of sewage treatment known as "intermittent sand filtration."

1. Excavate circular pit of not less than 5 feet deep and 8 feet in diameter.

2. The pit is lined with wall laid up of stones, old bricks or other suitable material without mortar in joints, leaving a space between this wall and the wall of the pit.

3. Fill in space between this wall and natural soil with coarse sand and gravel.

4. Fill in pit with fine gravel to provide a filter bed of at least 30 inches deep and allow 6 inches between bottom of soil pipe and top of filter bed.

5. Construct a suitable roof and sod over. It is essential for successful operation that the water level be kept well below the surface

of the filter, and in rare cases where the soil is nonporous, often joint subsurface drains should be installed.

INCINERATION OF WASTE PRODUCTS.—In order to illustrate the fact that the proper disposal of garbage for large bodies of troops is sometimes a more difficult procedure than it would appear, this occasion is taken to relate a personal experience with this matter.

While this writer was serving as post surgeon at the Marine Barracks, Quantico, Va., in 1917, one of the problems encountered, prior to the construction of the water-carriage system, was the disposal each day of several thousand gallons of semi-liquid excremental and other waste products. At first an effort was made to dispose of this matter, from the camp of about 5,000 men and laborers, by means of burial, but here the soil was clay and of a limited degree of porosity, which caused the pits to fill up more rapidly than a dozen laborers were able to dig them. Later various types of incinerators, which could be found described in the medical libraries of Washington, were tried out but all proved rather unsatisfactory for the cremation of such a large mass of waste products. The attempt to solve this problem by dumping the garbage and excreta in the Potomac river turned out to be even more unsatisfactory and insanitary, as the 40-inch tide caused the beaches in the vicinity to be littered with this refuse. There was a low degree of salinity of the water, and this, together with the agitation, tended to prevent rapid disintegration of the organic matter.

Finally the "hillside" method of incineration was devised and proved simple and satisfactory. It was described by the writer in the Journal of American Medical Association, April 6, 1918, from which the following is quoted:

> This method of garbage destruction consisted of a series of six parallel natural ravines located on the south side of a 15 foot bluff, which had a declination of from 50 to 60 degrees. Two of the ravines were used each day, one for kitchen and one for excremental refuse. The garbage wagon drove up to the end of the bluff and dumped the refuse on a small pile of brush wood, which acted as a strainer to retain the solids, allowing the liquid to be partly absorbed while the excess drained downward and was collected immediately beneath the brushwood in a series of small pools 2 or 3 feet in diameter.
>
> These pools were increased in size and number as the necessity demanded. The fire was started below the lowest collection of liquid and then gradually built upward. It was found that the lowest collection of liquid received the maximum heat, being nearest the fire, and tended to evaporate first.
>
> Consequently, after from 1 to 2 hours it was possible to pile fuel gradually upward and to completely consume the dry and semicarbonized matter remaining at the upper portion of the ravine, leaving the soil hard, dry, and sterile. At the close of each day these ravines were easily cleaned by raking the debris downward, using the tin cans and ashes to fill up small swamps.
>
> As the heat penetrates only 2 or 3 inches of the soil, a portion of the infected fluid may escape this sterilization action of the heat. This, however, depends

upon the permeability of the soil and the rapidity with which the fire is built upward.

This type of incinerator was constructed at Quantico and functioned very efficiently for several months in disposing of liquid and solid waste products—including both excremental and kitchen waste—prior to the construction of sewerage system and a permanent incinerator. It served satisfactorily a complement of nearly 10,000 (See figs. 6 and 7.)

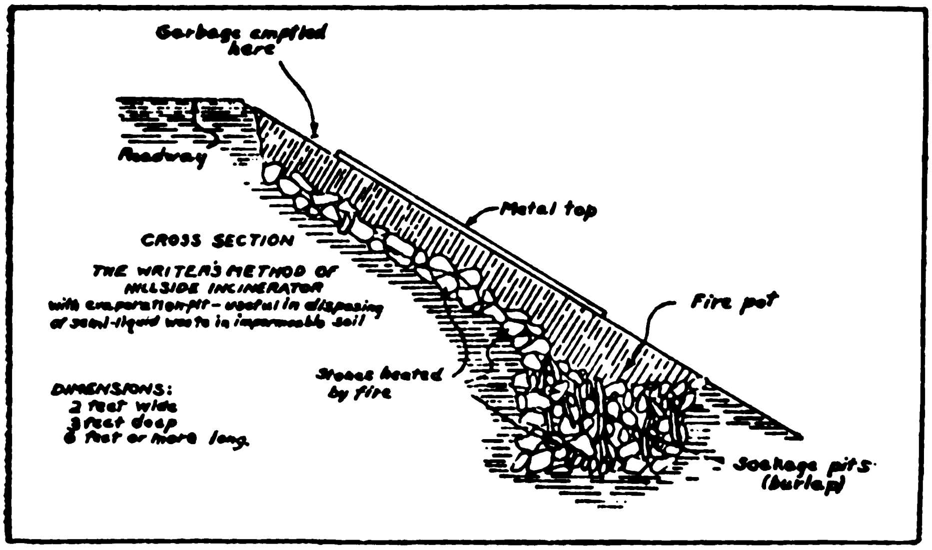

FIGURE 6.—Hillside incinerator. Dig trench on hillside 2 feet wide, 3 feet deep, and 6 feet or more long. Use a sheet of galvanized iron, or other metal material, as a replacable cover, to assist in creating a draft.

This mode of disposal has the following advantages:

1. Simplicity. One unskilled negro laborer effectively and efficiently disposed of the excremental and garbage refuse of 5,000 persons.

2. Availability. Almost every terrain contains a sloping hillside or a small embankment that may be utilized.

3. It requiries a minimum amount of fuel as the fire is below and the heated air rises and comes in direct contact with the liquids and semisolids.

4. The square area of the surface of the fluid which is exposed to the heat is greatly increased because of the earth's absorption, and this facilitates rapid evaporation.

In Quantico cantonment of 1917–18, each galley was equipped with its individual permanent incinerator alongside. The idea of prompt disposal of garbage *in situ* was another noble experiment, but unworkable in practice.

These permanent incinerators were odoriferous, inefficient, and difficult to operate. The use of these incinerators was soon abandoned, and no difficulty was found in disposal of garbage from all kitchens at a central incinerator modified hillside type.

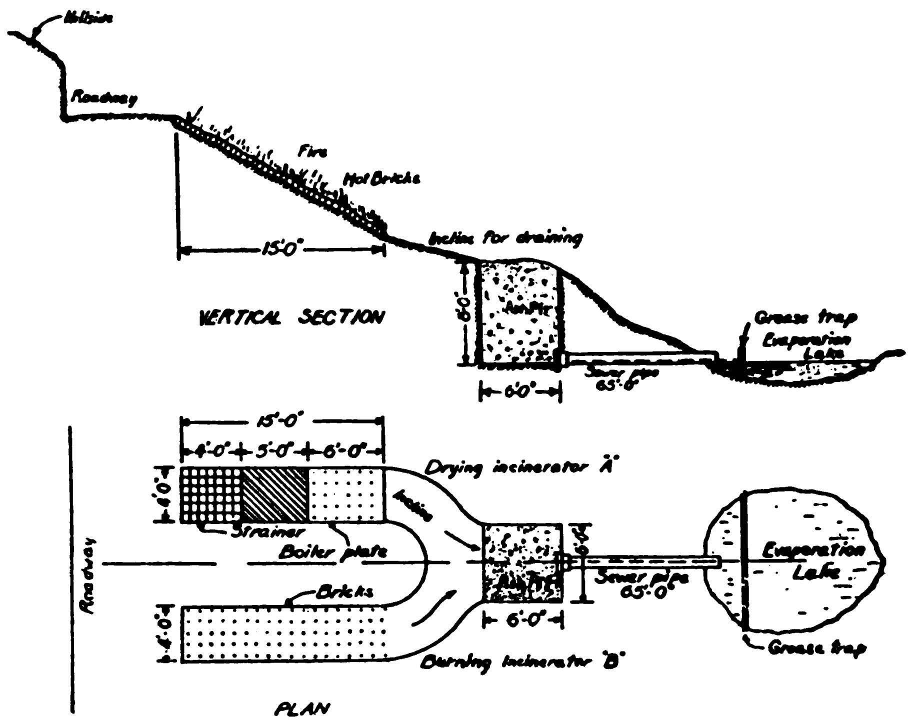

FIGURE 7.—The writer's method of hillside incineration for semi-permanent camps. The incinerators are built on the side of a hill with a slope of about 45 degrees. The garbage empties on strainers in incinerator A. After drying the solids are shoveled into incinerator B and burned. The liquids run to the bottom of incinerator and are partly evaporated by the hot bricks. Then they percolate through 8 feet of ashes, and are conducted through sewer pipe to lake.

The hillside incinerator probably will prove more useful if there is a large mass of semiliquid refuse to dispose of, and under conditions where pit latrines are not practicable.

Figure 8 illustrates a method of employing hillside incineration on level ground.

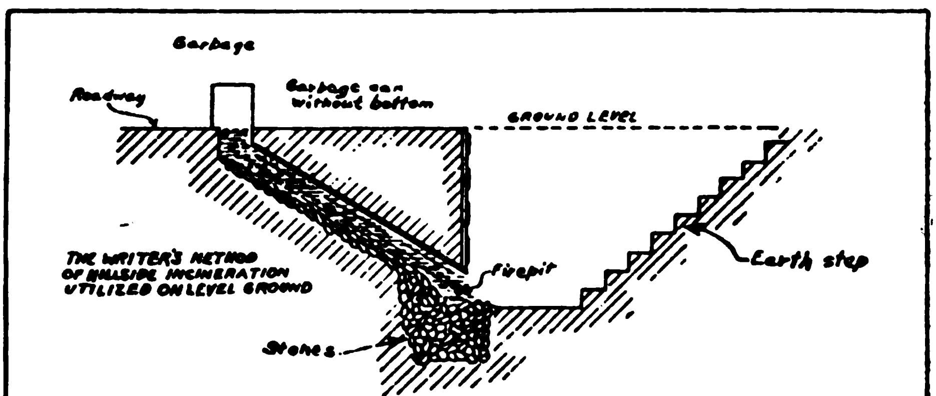

FIGURE 8.—Hillside incinerator on level ground.

Types and characteristics of incinerators.—

Open type.—

1. Easily constructed.
2. Requires less material for construction.
3. Practical in semipermanent camps.

Closed type.—

1. More quickly started.
2. Not so liable to be put out by rain.
3. Not so productive of bad odors.
4. Produces more heat.
5. Practical in permanent camps.

The cross trench incinerator.—This type of incinerator consists of two trenches intersecting each other at right angles to form a cross. The dimensions of each trench are 8 feet long, 1 foot wide and 1 foot deep in the center, sloping upwards from center to the surface at either end.

At the intersection of these trenches place scrap iron to act as a grate and serve as a support for a galvanized iron can with bottom removed, or a wooden barrel, covered with a layer of wet clay, may be used. The fire will destroy the wood and bake the clay which serves as a chimney.

The trench facing the wind is left open for ventilation and three other openings beneath the barrel are closed with a few shovels of earth. The trenches are lined with large stones, which become heated when the incinerator is in operation and thus assist in evaporation of any liquid waste.

Rock pile incinerator.—Dig a circular pit 15 feet in diameter and 3 feet deep; line the pit with boulders or mashed tin cans. In the center of the pit raise a pyramid of stones about 5 feet high which will serve to create a draft. A fire is built around the pyramid of stones and the garbage is later thrown on the pyramid where the solid matter is consumed and the liquid is evaporated by the hot stones.

One cord of wood will consume about 4,000 pounds of ordinary camp refuse, after the stones have been heated.

Closed type permanent incinerators.—Figure 9 illustrates a permanent incinerator installed in one of the camps of the Civilian Conservation Corps. Acknowledgement for the drawing is made to Lt. (Jr. Gr.) James B. Butler (M. C.) United States Navy, who is authority for the statement that this type of incinerator functioned very satisfactorily.

An incinerator to dispose of all types of kitchen garbage in permanent and semipermanent camps may be constructed as indicated in the accompanying diagram. This incinerator should be constructed about 200 feet away from the kitchen, and in a location

where prevailing winds are least liable to blow smoke toward the camp. It is advantageous to build the incinerator in a small grove of trees, if available. Trees serve as a windbreak, preventing scattering of papers, ashes, etc., and aid in carrying the smoke upward.

The incinerator is fueled by logs, the fire hottest at the middle and lower end, to prevent "burning out" and warping of the iron

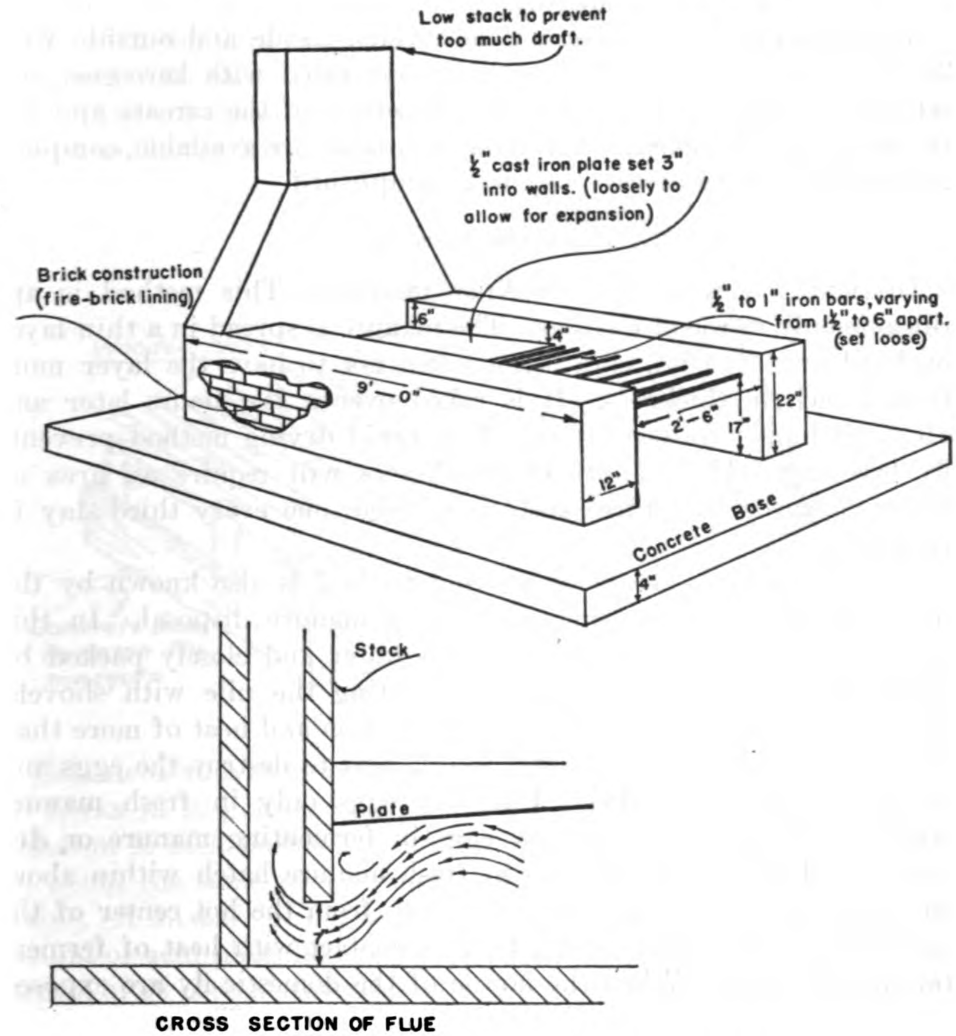

FIGURE 9.—Incinerator for permanent and semi-permanent camp.

plate. Wet garbage is deposited on the plate near the stack where it steams and dries slowly, agitation with a rake hastens drying. Portions which have become sufficiently dry, and large chunks of material, are raked over on the iron rods where they are burned and fall into the fire box. All but solid objects such as tin cans are reduced to ashes, which may be cleaned out occasionally and disposed of, preferably by burying. An incinerator of these di-

mensions should be large enough to dispose of all the waste in a camp of about 100 or 200 men.

Disposal of carcasses of animals.—The labor involved in burying a dead animal is considerable, consequently a combination of burial and burning is recommended.

A hole is dug beside the body, which is then disembowled and the internal organs are buried.

The disembowled carcass is then covered inside and outside with 30–40 lbs. of dry hay, or other litter, saturated with kerosene, and set fire to. This method aims at sterilization of the carcass and not incineration. If sufficient fuel, time and labor are available, complete incineration of the carcass may be accomplished.

Manure Disposal

Distribution method of manure disposal.—This method is applicable only in warm weather. The manure is spread in a thin layer on hard level ground, care being taken not to have the layer more than 1 inch in thickness. It is raked over a few hours later and all small lumps are broken up. This rapid drying method prevents fly breeding. The manure of 500 horses will require an area of 25 by 25 yards, and three such areas used, one every third day in rotation.

Close packing.—The close packing method is also known by the technical name "bio-thermic" method of manure disposal. In this method the manure is moistened with water and closely packed by gradually adding new manure and beating the pile with shovels. The center of the pile undergoes fermentation and heat of more than 150° F. is generated, which heat is sufficient to destroy the eggs and larvae (maggots) of flies. Flies lay eggs only in fresh manure which is damp, and do not lay eggs in fermenting manure or dry manure. Eggs which are laid in fresh manure hatch within about 24 hours and the maggots migrate away from the hot center of the pile to the cooler outer layers, because contact with heat of fermentation kills them. When the larvae of the domestic fly are exposed to a heat of 122° F. they die in about 3 minutes. The gases of fermentation kills them in about 1 minute at 124° F., in about 4 to 8 seconds at 139° F., and in from 4 to 6 seconds at 140° F. The daily amount of manure produced by one horse is from 1 to 2½ bushels.

Maggot trap.—The manure is stored on an elevated platform composed of parallel slats, underneath which is placed a receptacle containing water or some insecticide solution.

The pile is exposed, thus encouraging flies to lay their eggs. The eggs hatch into maggots, and the maggots burrow through the pile in search of earth, with the result that they fall between the slats into the solution below, where they are destroyed. This method

of storage has been utilized over fish ponds, or in poultry enterprises to furnish food supply at minimum cost. The professor of economic zoology at Columbia University was a strong advocate of the economics of this method. The maggots in manure of one horse will support six chickens, so it is claimed. (See fig. 10.)

Larvae traps have been designed for use in manure heaps. Empty tin cans with slits of a sufficient size to admit maggot forms are filled with dry hay and sunk into the manure pile so that the slits are flush with the surface. The larvae seeking a dry spot for pupation crawl into the tins and are later destroyed by burning. Several thousand larvae have been caught in this type of trap in 1 day.

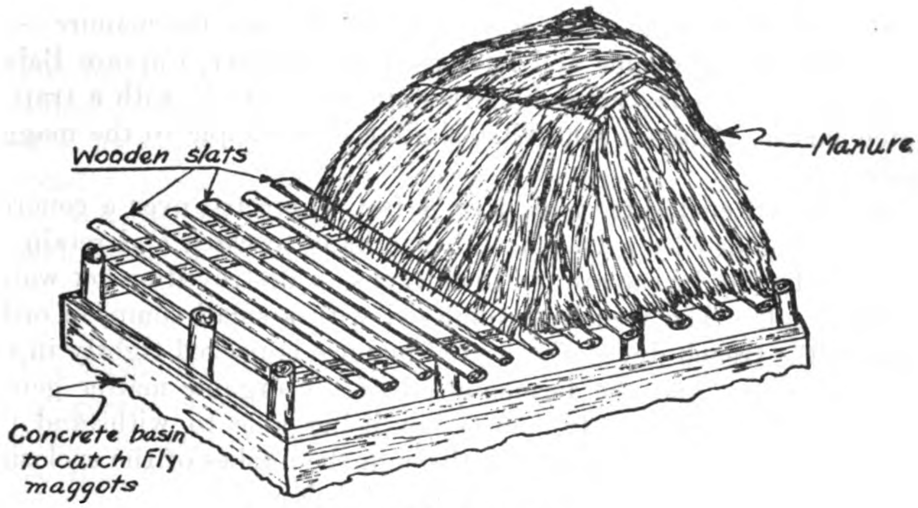

FIGURE 10.—Fly larvae trap.

CHEMICAL TREATMENT OF MANURE.—Dissolve two-thirds of a pound of borax in 10 gallons of water, using a little over a gallon of this solution to each bushel of manure. Powdered hellebore is also used in about the same proportions. These methods are of questionable value. A mixture of one-half pound calcium cyanamid plus one-half pound of acid phosphate to each bushel of manure gives a larvacidal action of 98 percent and adds nitrogen and phosphorus to the manure for use as fertilizer.

INCINERATION OF MANURE.—When the manure is not used as fertilizer, a wire hammock may be improvised and slung between two trees. The requisites are an amount of heavy wire, a pair of wire clippers, and some ingenuity. The manure is thrown on the hammock and burned. The hammock may be swung with a pendulum motion in order to increase the draft, which will facilitate the destruction of the litter. The hammock incinerator was devised at Quantico, Va., and proved very satisfactory method for the destruction of manure of several hundred horses and mules.

At one time a series of a dozen of these hammock incinerators were in operation in the incineration of corral waste. If the number of horses is small, an old wire bed spring may be used as a hammock incinerator.

Another useful method of manure incineration is to place the manure in piles about 2 feet high—known as windrows—sprinkle with oil and burn.

Rails from railroads may be used to construct an incinerator for the cremation of stable refuse.

Persistently wet weather may delay or prevent the burning of manure for some days, and during the rainy season in some countries incineration becomes impracticable.

Manure enclosure with maggot trap.—In case the manure is to be stored for some time and later used as fertilizer, Captain Baber, R. A. M. C., has devised a manure storage receptacle with a trap to catch larvae. This is somewhat similar in principle to the maggot trap.

A screened enclosure, 4 by 4 by 4 feet, is erected over a concrete base, surrounded by a trench with overhang to catch and retain fly larvae. The fly larvae are fed to chickens, or destroyed by hot water, or chemicals. The trench is connected with a small sump, in order to keep the trench dry. The wetted manure is packed tightly in the wire enclosure, and the fermentation of the organic matter generates heat, so that the fly larvae not being able to withstand the interior heat, come tumbling out through the meshes of the enclosure and fall into the maggot-retaining trench below.

Regarding the temperature, the following is abstracted from an article in the Journal of The Royal Army Medical Corps:

1. Fly larvae prefer a temperature of 90° F.
2. They quickly succumb to a temperature of 115° F., and under moist conditions a temperature of 108° F. is fatal.
3. Fresh manure placed in a firmly stacked heap will heat up to 140° F. inside of 30 minutes.
4. On the following day a temperature of 160° F. is reached.
5. On the 14th day the temperature declines to 130° F.
6. A temperature of 120° to 130° F. is maintained for 5 weeks.
7. The above applies to manure when wetted regularly with water.
8. A heap of dry manure, under identical conditions, consistently registered a temperature of 20° lower than the moist manure pile.

Waste Disposal Summary

1. Latrine construction.—
   Straddle trench—16 feet per 100 men.
   Deep pit latrines using standard QM box—2 boxes per 100 men.
   Pipe urinal—5 pipes per 100 men.
   Urine soakage pit—4 by 4 by 4 feet per 200 men, in favorable soil.

2. WASTE DISPOSAL (KITCHEN).—
   Less than 1 week—burial.
   Semipermanent camps—field appliances.
   Soakage pit—4 by 4 by 4 feet for 200 men in favorable soil.
   Barrel grease trap—1 per 200 men.
   Cross trench incinerator.
3. MANURE DISPOSAL.—
   Temporary camp—spreading.
   Semipermanent camps—close packing on oil soaked base.
   Permanent camps—used as fertilizer—storage bins on impervious bases. Not used as fertilizer—incineration.

FIELD MEASURES FOR INSECT CONTROL

The human race is at constant warfare with hordes of visible enemies—insects—which frequently act as carriers of myriads of invisible foes—pathogenic organisms and ova of parasites. This is especially true of conditions in the field, and for an expeditionary force to withstand successfully the attacks of insects requires detailed consideration of field measures for insect control.

FLIES

The havoc created by the flies in the dissemination of typhoid-fever germs in camps during the Spanish-American War is well known. A veteran officer of that war takes delight in telling the story that flies were so prevalent around the lime-covered latrines and the mess halls that the use of lime in the latrines was eventually discontinued on account of the fact that the food served at the mess had a limelike flavor.

The question of fly control is of tremendous importance in the prevention of disease in the field, so extended remarks on the life history are appropriate.

METAMORPHOSIS.—The fly develops, by metamorphosis, through successive stages so dissimilar as to suggest wholly different forms of life. The stages and their duration in temperate climates under the most favorable conditions are:

	Duration in days
Ovum or egg	⅓–1
Larva or maggot	4–8
Pupa or chrysalis	3–5
Adult	----
Total for complete cycle	7–14

In hot climates the average period is reduced, and the minimal period given above may be taken as the rule. Cold may prolong it for 3 months or more.

The egg must be kept warm if it is to develop, and it is therefore usually laid in vegetable or fecal matter which is about to ferment, the rapidity of chemical changes in which supplies the needed heat.

The larva of the fly has no digestive glands, and is therefore dependent upon predigested food or other readily assimilable food—another reason for the fly depositing its eggs in feces. Its most interesting habit is that of burrowing. It does so first to reach moister areas of its habitat; if disturbed, it hides with great speed; finally, in the prepupal stage, it comes to rest an inch or two beneath the surface of the ground in the vicinity of its feeding place. Having reached this haven its skin contracts, hardens, and darkens, thus forming the pupa-case within which the change to the perfect insect takes place.

The pupa remains without food for 4 days while developing into the adult fly. To enable it to escape from the pupa-case and force its way to the surface of the ground, the young adult is provided with a temporary structure, in the shape of a dilatable frontal sac, the so called ptilinum, the first use of which is to pry open the anterior end of the pupa-case. The young adult then emerges, and will escape through a depth of 6 inches of loose soil, and even through 6 feet of dry sand—the latter being a truly heroic effort.

Anatomy of the fly.—The adult has the following anatomical points of interest—

It is provided with a nonpiercing, retractile proboscis through which food is sucked by the powerful pharayngeal muscles.

The salivary glands are large, and saliva is freely expectorated onto dry foods, which are thus dissolved prior to ingestion.

The alimentary tract is provided with no other digestive glands. In addition to the stomach, the insect has a large crop capable of holding a 4 day's reserve of food. The hairiness of body and legs is remarkable. The feet are provided with minute hairs, bristles, terminal claws, and adhesive pads. The latter consists of surfaces covered with multitudes of fine hairs, and moistened by a glary, sticky substance, by means of which the fly maintains its foothold when inverted. For the conveyance of organisms in vast numbers, it would be difficult to imagine a more suitable apparatus than the fly's foot.

Habits of the fly.—Having had no food for 4 days, the emerging adult is so hungry that it seeks the nearest feeding ground, and gorges up to 70 percent of its weight at a single meal.

Its preference for certain foods is dictated by anatomical considerations. It must either get soluble carbohydrates or predigested protein; the former from kitchens and swill tubs and the latter preferably from feces. When both sources are available, the latrine and

kitchens are frequented alternately, hence the danger in the field from flies transmitting intestinal diseases.

When resting, the fly can often be observed to regurgitate crop contents, until there is suspended from the end of its proboscis a drop nearly as big as its head. This fluid is drawn in and out with gusto so long as the fly is undisturbed, but is dropped if alarm leads to hasty flight. A cropful of faecal fluid may thus be deposited on the surface of food ready for human consumption.

Well-fed house flies evacuate their bowels about once every five minutes, which brings up the statement, "There never was a constipated fly."

A fly will go upward through a hole, but seldom downwards, hence this fact is utilized as a principle in the construction of some flytraps.

Flies endeavor to avoid strong sunlight and tend to congregate in shady places in room light. They likewise avoid a dark place, hence lampblack is used, as a fly deterrent, to cover the interior of latrines.

These insects have a tendency to rest upon vertical rather than horizontal objects; they also prefer curved surfaces rather than plane surfaces. The latter two facts are utilized to catch the adults by suspending curved strips of fly-paper from the ceiling.

Flies tend to select certain colors and shades of color.

In conducting a series of experiments at Quantico, Va., by placing baited flytraps in the center of large squares of plaster board, each square painted a different color, the following deductions were made from the relative number of flies caught in the respective flytraps.

(*a*) Flies prefer a lighter shade to a dark one of the same color.

(*b*) Flies have a tendency to avoid blue colors. (I have subsequently learned that this fact was taken advantage of by painting the interior of living quarters blue.)

Flies can travel long distances—100 miles or more.

Temperature of 120° F. is usually fatal to flies; they are most active at a temperature between 80 and 90° F. and are torpid at 50° F.

Flies feed entirely upon liquid food; when they attack a solid—like sugar—the regurgitation of fluid from the crop serves to make a solution.

Prevention of fly breeding.—Flies breed in horse manure, excreta, decaying organic matter, and even in dirty rags and paper. One neglected stable may supply a horde of flies for an entire district, as a cart load of manure may harbor as many as 200,000 maggots.

Chickens feed freely on fly larvae growing in manure, and it has been claimed that six chickens per horse will keep down flies around a stable.

Garbage should be kept in covered containers to prevent fly breeding and should be removed frequently, especially in warm weather.

The suppression of flies resolves itself into a matter of cleanliness—organic cleanliness of the environment.

Grease traps must be covered and the surroundings kept clean and dry, or larvae will develop there.

The proper care of a picket line is a difficult problem. Daily removal of the manure with cleaning of the picket line and burning over of the area are only partially effective measures in the prevention of fly breeding. The heat of burning over the surface penetrates only from 1 to 2 inches of the ground and fails to kill the developmental forms which may be several inches under the surface. Digging up the picket line and saturating it with crude oil and tamping it down is fairly satisfactory.

Protection of food and personnel.—

1. *Prevention of access to flies; filth attracts flies.*—Cleanliness may be considered, in a negative manner, as the chief deterrent to the presence of flies.

It may be accepted as a maxim that: The presence of an undue number of flies is indicative that food or filth is exposed somewhere in the vicinity.

A marked reduction in the number of flies around the kitchen follows the simple measure of cleaning the outside of garbage cans.

In the routine inspection of a dozen or more kitchens in Quantico during the early days, one kitchen would be surrounded by swarms of flies while another nearby kitchen would be comparatively free from this insect, depending upon the degree of cleanliness of each place.

2. *Screening.*—In a permanent camp the kitchens, mess halls, and garbage cans should be screened. In a semipermanent camp screening may be impractical, consequently we must depend upon cleanliness and insect proof containers.

3. *Leaking screens.*—Unless the screening of a building is maintained in an efficient state, the use of screens is apt to do more damage than good. I have seen persons in quarters, enjoying a false sense of security by the mere presence of screening, yet the interior of the building was infested with more flies than it would have been if the screens had been removed. Leaking screens (especially cracks around the screen door) frequently convert the building into a large "flytrap"—flies are able to gain entrance into the building through leaking screens but are unable to get out.

Screen doors should be made to open outward and should be in direct sunlight, when practical.

During the malarial season in Quantico, Va., a man designated as the "screening inspector" was assigned to each organization. His duty was to inspect screens at regular intervals and to repair faulty screens. One of the places most apt to be overlooked is the space between the bottom of the screen door and the floor, a defect which may be remedied by using extra battens. Some of the other faults to be looked for include torn screens, warped doors, improper closing of doors, broken door stops, etc.

4. *Repellants.*—The use of essential oils as fly deterrents is unsatisfactory. Crude oil may be used around latrines to repel flies, and coating the interior of latrines with lampblack serves the same purpose

DESTRUCTION OF FLIES.—

1. *Muscicides.*—

Formalin (formaldehyde 40 percent), 50–60 cc, or about 3 tablespoonfuls.
Sugar, 20–25 grams.
Filtered limewater, 250 cc.
Water, add enough to make 500 cc.

The effect of this solution will not be very satisfactory in a humid atmosphere. The flies should not be given access to water when using this formalin solution. A 1-percent solution of sodium salicylate will also kill flies.

Fill a dish with the solution and place pieces of absorbent paper in it so that the paper will absorb the solution. As the solution is evaporated more must be added.

A small glass jar about half full of the solution is inverted on a flat bottomed dish which is covered with about three layers of absorbent paper. This is a very efficient method, as the paper is always kept moist by capillary attraction. A thick rubber band placed around the jar and plate will hold the jar in position.

Commercial fly sprays are effective. The basis of these insecticides consists of pyrethrum in kerosene, or similar hydrocarbons.

2. *Fly paper.*—Fly paper is very efficient for catching flies and is prepared as follows: Heat powdered resin 8 parts and castor oil 5 parts (by weight); stir well while heating; the mixture should not be brought to a boil. In hot weather the proportion of resin should be increased. Sugar or honey may be added, but it is not essential. The fluid is spread while hot over glazed paper. The mixture may be painted upon iron hoops or wire strands. Wires so painted will last for 2 or 3 days, when they should be cleaned and recoated.

3. *Flytraps.*—Fly traps consist of wire cones, glass-bell traps, and many other varieties.

Flytraps are constructed on the principle that flies are attracted by the sense of smell through a dark opening in the bottom or side

of the trap; after feeding they attempt to leave by flying upwards towards the light and thus into the trap.

Traps should be lifted a certain distance from the ground to allow free access to the flies and should always be baited with some attractively odorous substance. Molasses in water (molasses 1 part to 3 parts of water) or brown sugar (1 part of brown sugar to 4 parts of water) may be used as bait for flies. Both the above solutions increase in attractiveness when fermented.

The habits of flies should be considered in locating fly traps.

1. Flies will go from sunlight into room light, and will go from a dark room to a lighter one.
2. They congregate on lee side of a shelter.
3. They tend to avoid certain colors, such as blue.

Judging from the experiments conducted by one observer it would appear that the efficiency of flytraps is largely dependent upon the bait used in them. In these experiments 15 different kinds of bait were used and a total of 45,000 flies were caught.

The following are the results of 7 of the 15 types of bait used; the results of the other 8 kinds of bait are omitted for sake of brevity.

Kind of fly bait:	*Percent of total flies caught*
Fish head	31.34
Overripe bananas	21.30
Bran mixture	20.72
Canned salmon	14.00
Molasses, water, and vinegar	1.00
Sweet corn	.13
Mashes, cheese, and molasses	.10

Putrefying fish, kept moist with one part molasses to three parts of water, is said to make an excellent bait for fly traps.

The Ober flytrap.—(Quoted by permission from the lectures of Maj. M. C. Stayer, Medical Corps, United States Army, Army Medical Field Service School.)

This flytrap is in no sense new in principle, since it is substantially identical with some of the commercial forms. It is, however, in our judgment, by far the most readily constructed of any of them and the method of construction is such as to require practically no tools other than a saw and hammer. Two boards of equal width, best 11 to 12 inches, are laid off in triangles. Each pair of triangles form the ends of a trap and these ends are connected by three sticks of wood of any desired length. The usual way is to cut them of such a length that the wire screening that is available will just reach. If a 36-inch screening is used it may be cut in two and an 18-inch trap be thus made. A small triangle is cut out of the base of each of the ends. Beginning at the base, the netting is tacked onto the top of this smaller triangle, then onto the outer side of the base and around over the top of the trap and down to the starting point. One of the smaller triangles is nailed back on again, after the wire is tacked onto it. The other triangle is not nailed, but is held in place by two small wood or iron

buttons. At the angle formed by the apex of the small triangle small holes are made by pushing a lead pencil through the screen at intervals of about 1 inch. A nail or screw is placed at each corner of the base so as to raise the trap a quarter or three-eighths inch off the ground. The bait is placed under the trap and the fly when it finishes feeding crawls up through the openings into the trap. Nothing can be simpler than the construction of this little trap, it being far easier to build than a box-shaped trap and requiring much less lumber. Its efficiency is not different from any other trap of similar size.

The ease of building is seen when it is stated that several hundred of these were built with ordinary fatigue details in a very few days at the Fort Riley laboratory. To remove the flies all that is necessary to do is to turn the two buttons holding the loose triangle in place, to depress this latter slightly, and, on raising the other end of the trap, the flies slide right out, being directed to the opening by the screen wire. It can be emptied in a very few seconds with very much less trouble than any other trap which we have seen.

Window screen fly trap.—As described by Maj. A. P. Hitchens (MC), United States Army, and published in the Military Surgeon of July 1933:

Flies have been found to have the habit of finding and using the smallest holes to enter a room. In the window screen trap this habit is utilized to trap them.

The window screen trap takes the place of the ordinary screen of window or door. It consists of a shallow box, about 4 inches in depth, covered on each side with screen wire. Before the screen wire is tacked on the box it is bent so as to make small grooves at 4-inch intervals. Small holes are punctured through the apices of these grooves at 1-inch intervals. The grooves of outer screen are placed pointing inwards. This double screened box is then placed in windows or doors of rooms that are naturally attractive to flies. In their effort to get in, and also to get out of this room, they enter the grooves and pass through the holes into the trap. Such traps are very efficient on the window and door openings of stables.

Conical hoop trap.—Dr. F. C. Bishopp, principal entomologist in charge, division of insects affecting man and animals, Bureau of Entomology, Department of Agriculture, illustrates (see fig. 11) and describes this trap in Farmers' Bulletin 734. The trap consists essentially of a screen cylinder with a frame made of barrel hoops, in the bottom of which is inserted a screen cone. The height of the cylinder is 24 inches, the diameter 18 inches, and the cone is 22 inches high and 18 inches in diameter at

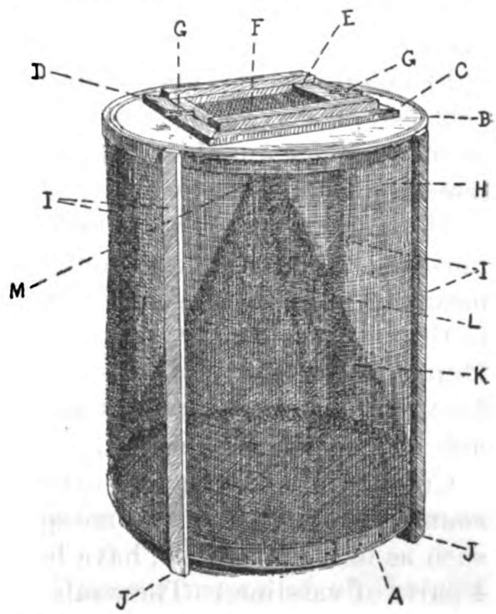

FIGURE 11.—Conical hoop fly trap (Bishopp).

the base. The apex of the cone is then cut off to give an aperture 1 inch in diameter.

On the basis of extensive tests, Dr. Bishopp reports that this trap is best for effective trapping, durability, ease of construction and repair, and cheapness of construction. At Quantico we have found the conical hoop trap very effective.

Fly swatting.—Flies gaining access to kitchens and mess halls should be killed by swatting with fly swatters. Fly swatters consist of a piece of wire mesh, leather or rubber, tacked to a long handle. When rubber or leather is used it should be well perforated. The free edges of the wire mesh may be covered with leather if so desired.

Electrocution of insects.—Copper wires are interwoven alternately across an insulated framework and spaced one-fourth of an inch apart on screen doors.

The screens are supplied with a high tension static charge of electricity from a small transformer, which produces a charge of approximately 3,500 volts and less than 0.05 millampere.

These doors are said to have killed as many as 15,000 flies on a summer day.

Mosquitoes

The field measures undertaken to combat the activities of the mosquito in the transmission of disease are as follows:

Medicinal prophylaxis.—It appears to be the generally accepted opinion that the routine internal administration of quinine as a prophylaxis against malaria is of questionable value, but the treatment of malarial carriers with quinine, plasmochin or atabrine is an important factor in the prevention of the dissemination of this disease.

Personal protection.—Screening of living quarters in permanent camps may be utilized by using mesh screen having 16 meshes to the inch for anopheles—18 meshes to the inch must be used when screening against stegomyia mosquitoes.

The female mosquito, which is nocturnal in its feeding, transmits the malarial germ, consequently sleeping nets are our chief means of reducing the possibility of the transmission of this disease to troops on field duty. This article of equipment is supplied by the United States Marine Corps to every individual of an expeditionary force. If the circumstances warrant, all sentinels should wear head nets and gloves after sunset.

Culifuges.—Kerosene is extensively used in some of the tropical countries as a repellent to mosquitoes, and some of the essential oils, such as oil of citronella, have been used. (One part of citronella to 4 parts of vaseline.) These oils have little practical value in the field as their effect will not last through one night.

A very good insect repellent consists of:

Oleum anisi	2 drops.
Oleum eucalypti	Do.
Oleum terbenthae	Do.
Lanoline	1 ounce.

Light shades of color, especially yellow, are repellent to anopheles mosquitoes, dark shades are selected, especially navy blue. The stegomyia mosquito prefers a dotted white surface.

MOSQUITO DESTRUCTION.—The adult mosquitoes may be killed by fumigation—burning 2 pounds of sulphur for each 1,000 cubic feet of space.

Mosquitoes are infinitely more susceptible to the action of insecticide sprays thans flies. The standard Navy issue insecticide is the best spray for this purpose and should be carried in stock by the supply officer or quartermaster.

Mim's culicide consists of equal parts (by weight) of carbolic acid crystals and gum camphor. The acid is slowly melted and then poured over the camphor, thus forming a clear volatile liquid. Volatilize 3 ounces of this mixture for every 1,000 cubic feet of space.

The following formula has been reported as an excellent insecticide spray:

	Parts
Carbon tetrachloride	1
Oil wintergreen (synthetic)	2
Kerosene	97

Naphthalene—¼ pound added to each gallon of above mixture.

Mosquito traps and swatters are sometimes used for the destruction of adult mosquitoes. Destruction of wintering adults is said to be very effective in reducing malaria.

DESTRUCTION OF MOSQUITOES IN DEVELOPMENTAL STAGE.—Mosquito-breeding areas may be controlled by oiling, and crude petroleum is the oil usually selected. When the mosquito larvae, commonly called wiggle-tails, come to the surface for air the oil clogs their breathing apparatus and kills them by asphyxiation.

About one-half ounce of oil suffices for every square yard of water surface under normal conditions, e. g., small areas where the wind does not blow the oil aside. The application of this amount of oil once a week is sufficiently frequent to destroy each crop of larvae. It requires 10 or more days for the cycle—from the egg to the adult mosquito. For ornamental fish and lily ponds use gasoline, one-half gallon to each 100 square feet.

There are several different methods for oil distribution upon water surfaces.

The "knapsack sprayer" is a well known means of oil distribution, and is often utilized.

The "Panama dripper" consists of an oilcan with a faucet near the bottom which allows the oil to fall on the water, drop by drop (usually at the rate of about 30 drops per minute), and furnishes a means of continuous oiling of a running stream.

The "submersible oil bubbler" devised at Quantico, acts similarly to the above, except that the device is completely submerged and the oil comes from below upward. The advantage of this method

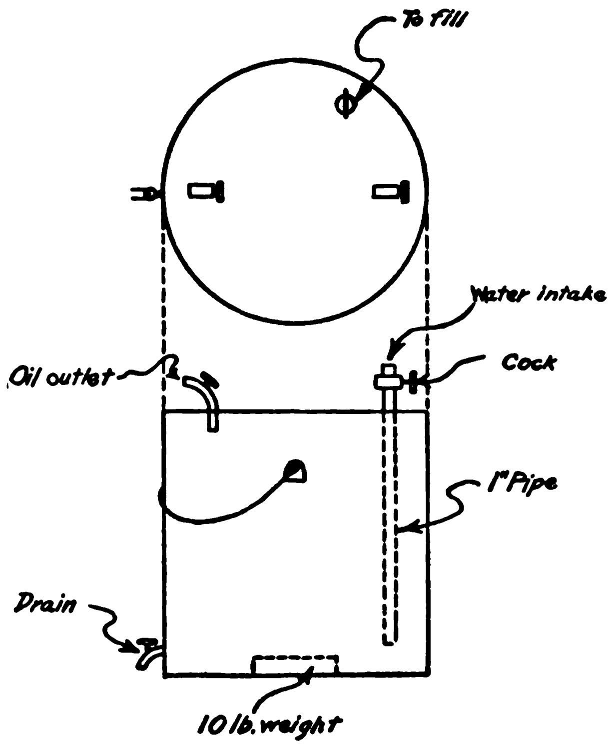

FIGURE 12.—Quantico type of submersible oil bubbler.

is that the device is less apt to be interfered with by unauthorized persons and the flow of oil tends to be more uniform and less affected by a change in temperature. These cans are removed and refilled once a week. The container is filled with oil and sunk in the stream of water. The oil, at rate of 40 to 60 drops per minute, is released and comes to surface, forming a uniform film of oil to destroy the "wiggle-tails" of mosquitos. (See fig. 12.)

The "oil soaked sawdust" method of petrolization (also originated at Quantico), affords a simple means of distributing oil over mosquito breeding areas. This method was worked out contemporaneously and independently by the United States Public Health Service. The oil soaked sawdust is placed in a wire cage or in perforated boxes which are partially embedded in running streams. The cages were found to be effective without renewal of the oil for a period of from 2 to 3 weeks. (See fig. 13.)

Oil soaked sawdust can be placed in paper bags, which are thrown into marshy vegetation. The bags rupture and liberate the sawdust, the particles of which give a widely distributed film of oil, scattered throughout the aquatic vegetation.

Where there is dense surface vegetation, such as water lilies, the oil impregnated sawdust may be thrown at random among the vegetation and floatage; each individual particle becomes a means of slowly liberating oil. (Vide Military Surgeon, November 1918, for more complete details of the last two methods.)

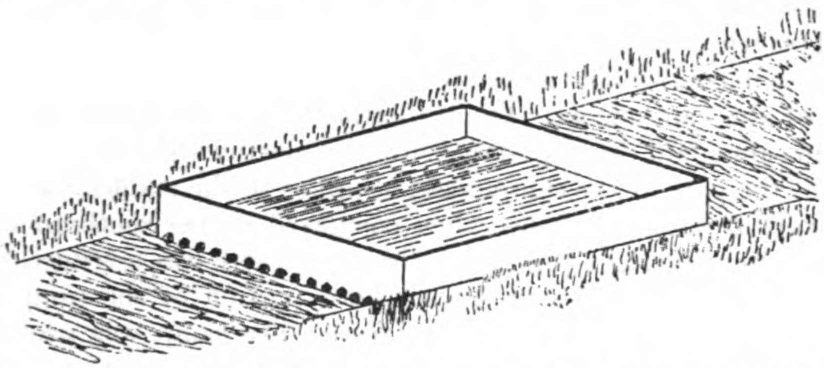

FIGURE 13.—Quantico method of petrolization with oil-soaked sawdust. (Ebert.)

The Panama larvicide consists of carbolic acid, rosin, and caustic soda combined in such a manner that the product has approximately the same specific gravity as water. This larvicide has the advantage over oiling inasmuch as it kills the larvae of one species, *Mansonia titilans*, which does not come to the surface of the water but gets its air from the roots of water plants. One part of this preparation to 5,000 parts of water will kill larvae.

Other chemicals, some of which are byproducts in the manufacture of gunpowder, have been employed as larvacides. Arsenic dusting by hand, or airplane, is a more recent development.

DRAINAGE AND FILLING.—Where the mosquito breeding area is below sea level and cannot be drained, it may be flooded with salt water to prevent breeding. In other undrainable areas deep canalization may be used to reduce the water surface to a minimum, which may then be easily controlled by oiling.

Small swamps and marshes may be filled with dirt, ashes and debris.

A comparatively small amount of stagnant water will furnish sufficient breeding area to infest a small camp with mosquitoes.

A camp located about a mile from mosquito-breeding areas is considered fairly safe from anopheles. In the selection of a camp site one should endeavor to avoid the proximity of habitations, as these dwellings are apt to harbor mosquitoes and human malaria carriers.

All tin cans, broken bottles, and other receptacles which will retain water should be immediately disposed of. A well recognized authority on mosquitoes informed the writer that he was unable to locate the source of infestation of an isolated dwelling house until he discovered a broken rubber ball containing water; the removal of this breeding place was followed by a reduction in the number of mosquitoes at this place.

Biological barriers.—It has been demonstrated that anopheles do not travel far from breeding places if a food supply is close by, and this fact is taken advantage of in the use of "biological barriers."

In Quantico, during the World War there were undrainable and otherwise uncontrollable mosquito breeding swamps to the north and south of the cantonment. On inspection anopheles were found to be very abundant in the stables to the northward of the camp, whereas the part of the cantonment adjacent to the stables was comparatively free of anopheles when compared to the southern edge. Shortly after placing a pig pen to the south there was a reduction in the number of anopheles in the southern portion of the camp and large numbers were found in the pigpen. The camp was protected from mosquitoes by "biological barriers," stables to north, and pig pens to the south which tended to stay flights of mosquitoes in their search for food.

Hence it does not seem improbable that the use of animals as biological barriers may be put to practical advantage by establishing the corral and stables between the camp site and the mosquito breeding areas.

Mosquito control at Quantico by airplane dusting.—Airplane dustings start on swamp land of both creeks about the 1st of July (depending on anopheles breeding) and are continued on a 10- to 14-day schedule throughout the summer until about the 15th of October. The mixture used is composed of one part paris green and four parts powdered soap stone, and is dusted in the proportion of 5 pounds of the mixture to the acre as follows:

	Acres	Pounds mixture to 1 dusting
Chapowamsic Creek	240	1,200
Quantico Creek	160	800
Total	400	2,000

Cost per dusting:	
Paris green, 400 pounds at $0.21 per pound	$84.00
Powdered soap stone, 1,600 pounds at $0.0082 per pound	13.12
Total cost per dusting	97.12
Total cost per season for dusting materials (10 dustings)	$971.20

Oiling.—All breeding areas in the post proper, town of Quantico and the areas surrounding for approximately one-fourth mile beyond, are sprayed on a 7- to 10-day schedule with a mixture of used crank-case oil 49½ percent, kerosene 49½ percent, and castor oil 1 percent. The amount of this mixture used is about 500 gallons per season from May to October inclusive.

Cost of Oiling:	
Crankcase oil, 5,000 gallons at $0.000 per gallon	$0.00
Kerosene, 5,000 gallons at $0.066 per gallon	330.00
Castor oil, 50 gallons at $1 per gallon	50.00
Total cost of oiling mixture per year	380.00
Cost of Labor:	
3 laborers at $4.128 per day for a period of 30 weeks	1,857.60
Cost of mosquito control exclusive of service:	
Cost of airplane dustings	971.20
Cost of oiling mixture	380.00
Cost of labor	1,857.60
Total cost	3,208.80

Lice

Various methods are employed for delousing purposes. N. C. I. powder, which is considered very efficient in the destruction of lice, consists of the following: Naphthalene, 96 parts; creosote, 2 parts; iodoform, 2 parts.

This powder is dusted inside of wearing apparel, care being taken to avoid the forks of trousers, as this preparation, if used too freely, is an irritant to the perineal region and may cause a dermatitis. After the use of this mixture the soldier should wrap himself up in a blanket in order to retain the fumes which are generated.

Vermijelli is less irritating than the above mixture, and is composed of the following ingredients: Crude mineral oil, 9 parts; soft soap, 5 parts; water, 1 part. This preparation will kill adult lice but has no effect on the eggs.

Clothing may be deloused by immersion in kerosene or gasoline.

Ironing of clothes will kill both the adults and the eggs; steam heat will accomplish the same purpose. The "Serbian barrel" and the "sack disinfestor" are two simple methods of using steam heat in the field.

The Serbian barrel disinfestor consists of a barrel with a perforated bottom and a tightly fitting removable cover which is weighted down with stones. The barrel is placed over a tank of boiling water; the steam generated from the boiling water flows under

pressure into the barrel. The water must be kept boiling at all times while this barrel is in use.

Clothes and other articles may be disinfested by the above means. The "sack disinfestor" devised by Lt. Col. P. S. Lelean, R. A. M. C., depends on the principle that steam entering the upper portion of the inverted bag displaces the air in its course downward and produces an extra atmospheric pressure (about 15 pounds per square inch) which pressure in turn raises the temperature of the interior of the sack to 107° C.

The sack disinfestor is useful for disinfection and disinfestation.

For a detailed description of this device see United States Naval Bulletin for September 1922.

HEAD LICE.—For the destruction of the head louse, *Pediculus capitis*, acetic acid (10-percent solution) is applied. Equal parts of kerosene and olive oil are sometimes employed in place of the acetic acid solution. The hair should be combed with a fine-tooth comb.

PUBIC LICE.—The methods for the destruction of this louse are well known and will not be considered here.

BEDBUGS

There are two species of bedbugs, namely, the *Cimex lectularius* and the *Acanthia rotundata.*

The *Cimex lectularius* is the common bedbug found in the northern climates while the *Acanthia rotundata* is found in the tropical regions.

The eradication of this parasite, especially in the tropical regions, is a very difficult problem.

Fumigation provides very effective extermination. It is a method to be employed primarily in sealed spaces. Carboxide gas is highly recommended. For detailed information on the employment of this agent the reader is referred to articles by Captain E. W. Brown (MC), U. S. Navy, published in this Bulletin, Vol. XXXI, page 253 (1933), and Vol. XXXII, page 294 (1934). Hydrocyanic-acid gas is equally efficient but should be employed only by personnel skilled in its use.

The blow-torch is effective when applied to cracks of metal beds.

Kerosene, gasoline, and other chemical insecticides may be poured into crevices to exterminate this pest.

The beds may be immersed in a solution of caustic soda for a period of 15 minutes (strength of soda solution is what is usually employed in washing clothes). After immersion they are washed in clear water and allowed to dry in the sun. This method is said to kill both the adults and the eggs.

Heating rooms and even entire buildings to a temperature of 120° to 125° F. for several hours will completely eliminate bedbug infestations. Superheating has been resorted to repeatedly with success during hot summer weather when advantage can be taken of the normally prevailing high temperatures. In summer, most home heating equipment is sufficient to raise the temperature of infested rooms to 120° to 125° F., if not higher, without harm to the furnishings. It is well to place thermometers in various parts of the room or rooms in order to note the temperature obtained. The temperature in the cracks where the bugs are secreted must be held as high as 120° F. for several hours. In loosely constructed frame buildings it may not be possible to secure a killing temperature at points close to wall spaces. Some institutions, such as colleges operating dormitories, find the heat treatment effective and cheap.[3]

Cockroaches

There are four domesticated species of this family, namely, the Oriental, German, American, and Australian roach.

Sodium fluoride blown in corners and crevices is a standard poison for this pest. The roaches walk through the powder, some of which adheres to their legs, and are killed by the sodium fluoride when it gets into their mouths. (They clean themselves with their mouths.)

Another cockroach poison consists of dry plaster of paris, 1 part; flour, 3 parts. When using the above mixture a dish containing water should be close by. The insect, after feeding upon this preparation, becomes thirsty and seeks water, which sets the plaster of paris and kills by clogging the intestines. Pyrethrum is extensively used as an insecticide for the extermination of cockroaches and other insects. It is incorporated in the Navy issue liquid insecticide.

Fleas

Pyrethrum powder is effective for removing fleas, *Pulex irritans*, from the body.

Iodoform and oil of pennyroyal act as repellants.

An emulsion of 5 percent cresol, with or without soft soap solution (20 percent); gives excellent results.

Sprinkling a flea-infested floor with flaked naphthalene and closing the room for 24 hours is very effective. A solution of naphthalene in gasoline should be poured into all holes—such as mouse holes—in treatment of plague infested houses.

[3] United States Department of Agriculture Leaflet No. 146.

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Common disease transmitting insects

Common name	Species	Common diseases transmitted	Breeding places	Life history	Range of flight
Flies	Musca domestica.	Typhoid fever, cholera, dysentery, diarrhea, smallpox, erysipelas.	Manure, garbage, decaying organic matter.	Eggs hatch out in 12 to 24 hours in larvae; larvae grow rapidly and in 4 to 5 days become pupae (resting stage). In 2 to 4 days mature into adults.	Several miles
Mosquitoes	Anopheles	Malarial fever	Rural stagnant pools, among grass and rushes, swamps and marshes.	Ova deposited in mass of 250 eggs, 2 to 4 days hatch into larvae, and in a week reach pupae or wingless resting stage; in 2 or 3 days develop wings and become adult mosquitoes.	One-half mile, usually against wind.
Do	Stegomyia	Yellow fever	Domestic, develop in water in any container near a house or in gutters, cisterns, spouts, etc.	Female lays about 70 eggs, larvae hatch out in 2 days and develop into pupae in 1 week; then in 2 or 3 days become mature adults.	Maximum 75 feet. Usually hide in nooks away from wind.
Lice	Pediculus	Typhus fever, relapsing fever.	Breed and spend their entire life on warm blooded animals, including man.	Eggs cling to hair or clothing of host (man); they hatch out in 3 to 4 days and mature in 10 to 15 days.	Do not travel much; keep close to one host.

HYGIENE AND SANITATION OF THE MARCH

Military Value of Marching

The ability to march has always been—and the results of the World War tend to show that this is still true—one of the determining factors of victory. The superiority in marching ability of troops enables the responsible commander to secure the preponderance of men at the critical time and place. Infantry, in spite of the rapid development of other branches of the military service, is still the dominant arm. Artillery without the defense of infantry is vulnerable. It is stated by authorities that well-trained infantry can endure longer marches than cavalry.

As one leader said "Getting there first with the most men was the secret of his victories." "Battles are won more by sweat than by slaughter." Strength of legs rather than strength of arms won battles.

General Thomas Jonathan Jackson—"Stonewall Jackson"—of the Confederate Army, was an outstanding military leader who was quite familiar with the care of troops on the march, and owed much of his military success to this one fact. He always started his

organization on the march at dawn unless—as one jovial Confederate remarked—he started them the night before. General Jackson gave his troops very frequent but short rest periods and never broke his soldiers by long sustained physical effort. At the rest periods his men were compelled to lie flat on the ground and thus "rest all over." Jackson stated that he would rather lose one man in marching than five in fighting, and due to the marching ability of his organization they were termed "foot cavalry." One of his record marches was on March 23, 1862, when his troops covered 40 miles in 1 day and fought a battle (Kernstown) in addition. In the Valley Campaign, Jackson's Army covered 676 miles in 48 marching days (average 14 miles per diem), and fought 13 battles and skirmishes during this period. The marching ability of his men thus enabled Jackson's force of 15,000 to cause 175,000 Federals to be held out of main operations around Richmond.

In 1896, a force of 3,000 Russians marched 3,000 miles and averaged 14 miles per day. They arrived at their destination in excellent health, with only 33 men missing from the original number. In 1805, the Grenadiers of Oudinot pursued the enemy for 3 consecutive days, the daily marching being 30, 40, and 50 miles respectively.

Marlborough's force in 1711 covered 40 miles in 18 hours; Friant's Division marched 78 miles in 46 hours and next day (December 2) fought in the Battle of Austerlitz. The record march is that of the Light Division at Talavera, in July 1807, which marched 62 miles in 26 hours and carried full equipment weighing 50 to 60 pounds. An expenditure of energy equal to 1,600 foot-tons.

In modern warfare use has been made of mechanical transportation to effect great concentration of men, but usually at the last moment, due to congestion of the arteries of traffic and to other causes of impassibility of the roads, there is a call for a test of physical endurance in marching.

In preparing for the Battle of the Somme on March 21, 1918, the Germans concentrated their troops by maneuvering them into position by long marches. For several months previous the German divisions were trained to endure long marches, and only 5 days before the battle many of the troops were far from the battlefield, and some covered 60 miles in 3 nights of marching preceding the battle.

To be able to endure long marching requires careful training and attention to a host of trivial details. The writer has endeavored to collect and compile the data on this subject in hopes that the student will carefully study them in order to be familiar with the details for use in event of emergencies. These apparently inconsequential details assume great proportions to a weary, footsore marching unit.

According to the Field Service Regulations, United States Army, "Good marching is secured by careful preparation, strict discipline, and observance of march sanitation."

Physics and Physiology of the March

Physics of the march.—A soldier weighing 160 pounds, carrying 40 pounds and walking 15 miles at the rate of 3 miles per hour on a level surface will perform an amount of work equivalent to 353.57 foot-tons.

According to Haughton, as quoted by Harrington, this labor, in walking over a level surface, is determined by the following formula:

$$\frac{(W+W')\times D}{2240}\times C = \text{foot-tons.}$$

W = weight of person.
W′ = weight carried.
D = distance in feet.
2,240 = number of pounds in long ton.
C = coefficient of traction.

The coefficient of traction varies for different rates of speed, with the character of the terrain, and wind effect. For 2, 3, 4, and 5 miles per hour, on a level surface, it is approximately 1/26, 1/20, 1/16, and 1/14, respectively.

$$\frac{(160+40)\times 79200}{2240\times 20} = 353.57$$

Physiology of the march.—Compared to the steam engine the human mechanism is a bit more efficient, as the engine is capable of utilizing only 13 percent energy for useful work from its fuel, our body is able to utilize 20 percent of the energy value of our diet, the 80 percent balance goes in the production of heat which must be dissipated in order to keep the body temperature constant.

The unit of energy is the calorie, which is equal to the amount of heat necessary to raise 1 gram of water 1° C.

This is the small calorie, and we generally use the kilocalorie, or the large Calorie, represented by a capital "C," which is the amount of heat required to raise 1,000 grams (about 1,000 cc) of water 1° C.

A soldier at rest requires 3,000 Calories per day, of which one-fifth (600 Calories) actually goes into work, and four-fifths (2,400 Calories) is dissipated as heat.

The evaporation of perspiration acts in dissipating heat of the body similar to the radiator of the automobile in maintaining the motor near a constant temperature.

The evaporation of 1 cc of water requires 0.5 Calories, consequently the evaporation of a quart of water—(Imperial measure, 1 quart=

1182.52 cc)—from the body's surface will dissipate 600 Calories of heat.

To produce 350 foot-tons of work, such as our example of the marching soldier, would require the expenditure of 254 Calories as muscular energy. Since the body is only 20 percent efficient the total expenditure of energy to produce this work would be 1,270 Calories, of which 1,016 Calories are dissipated as heat. The soldier normally expends 1,000 Calories in 8 hours. Therefore, the total caloric need of the soldier during the 8-hour march is 2,270 Calories, of which 1,816 Calories must be dissipated as heat.

Of the 1,816 Calories, 30 percent is disposed of by radiation, conduction, and convection, while the remaining 70 percent of the 1,816 Calories (equals nearly 1,300 Calories) must be disposed of by evaporation of fluids. Since the evaporation of 1 quart of water takes 600 Calories, then the total water which must be lost in this 8-hour march is approximately 2 quarts, provided the entire amount evaporates on the body surface.

Effects of water loss:

Miles marched	Quarts perspired	Soldier's condition if water is not replaced	Miles marched	Quarts perspired	Soldier's condition if water is not replaced
7½	1	Habit thirst.	30	4	Danger.
15	2	Thirst of necessity.	45	6	Death.
22	3	Marked inefficiency.			

The physiology of perspiration is vitally connected with heat stroke and heat exhaustion which result from failure to dissipate the excess body heat. As body heat increases due to increasing labor or to increasing accumulation from the environment, a fireroom for example, the function of perspiration becomes of greater importance in keeping body temperature normal. Men should be thoroughly indoctrinated in a few simple facts:

1. Perspiration lowers body temperature only when it evaporates from the surface of the body. Evaporation is retarded when the air is still and has a high degree of humidity. Light, loosely worn clothing promotes evaporation by retaining perspiration on the body surface. Water of perspiration that runs off the body or is wiped off represents a loss and the amount of this loss should be added to the second column of the accompanying table.

2. The body has a comparatively small reserve supply of water and when this reserve is exhausted the body ceases to perspire. Since this is the major factor that keeps the body heat normal, heat stroke or heat exhaustion follows. Therefore, water loss should be promptly replaced.

3. Furthermore, ordinary table salt is an essential factor in control of body temperature. The body can neither absorb nor perspire salt-free water. The reserve stock of this salt is limited. When this reserve is exhausted the body will cease to perspire even if the supply of water in the body is ample and it will not absorb water from the intestinal tract even though large quantities are drunk and there is great need for the water. This condition of insatiable thirst and diarrhea can be corrected by adding salt to the water. Prophylactic treatment consists of supplying salt to men perspiring excessively.

Preparation for the March

It is remarkable to note what improvement in marching ability can be effected in a few weeks of graduated exercise and muscular training. One investigator conducted a series of experiments on an untrained man marching a certain distance in a given time with the following results:

Untrained soldier:
- Increase in pulse 72 beats.
- Increase in temperature 2.2° F.
- Loss of weight 2¾ pounds.

After 3 weeks' training:
- Increase in pulse 28 beats.
- Increase in temperature 0.6° F.
- Loss of weight 2¾ pounds.

The men should be trained in marching by increasing the length of the hike and the weight of the pack. They should be so trained for several months. This training means the development of all muscles in the body—an increase of capacity of the lungs and heart, also strengthening of the foot arches, and the like. It is at this time that the medical officer should keep close supervision over the men. Overtraining defeats our purpose and leads to cardiac dilatation and eventually to exhaustion.

Men under training should be given periods of mental and physical relaxation and recuperation. It is remarkable how quickly the human mechanism develops with progressive and systematic exercises. The raw recruit under proper supervision shows rapid development within a few weeks of training.

The men should be trained to breathe through the nostrils, as in this way dust and other foreign bodies are removed from the air before it reaches the lungs, and the air is warmed. Mouth breathing tends to dry the mouth and thus increase the sensation of thirst.

A person marching at rate of 4 miles per hour inhales five times as much air as when reclining.

Conduct of the March

The most suitable time to start a day's march is 1 hour after the break of day. Night marching should only be practiced when military necessity demands, and then should begin soon after sunset.

The canteens should be filled preferably the night before the march. The sick and the physically unfit should be eliminated at the morning sick call. By all means avoid premature assembly of the men—get them "under way" as soon as practicable after "falling in." A light breakfast should be served.

The sanitary officer, with a police detail, remains for a few minutes after the camp is cleared to see that all waste and litter are disposed of, latrines filled in and labeled, and that the camp site is otherwise left in a clean and sanitary condition.

Rate of march.—The human mechanism—similar to the automobile motor—must be warmed up before it can function at its best in marching.

The physiological best temperature for the body in marching is 100.5° F. and 102° F. is the maximum temperature before serious symptoms become noticeable, such as swaying, tremor, nervousness, etc. Thus there is only 1.5 degrees range between the optimum body temperature and danger body temperature "and this narrow safety margin indicates alike the delicacy of the adjustment mechanism and the importance of every means of aiding that adjustment."

A horseman always starts his horse off slowly, and the end of the ride is made at slow pace. Likewise the infantry leader should start his men off slowly so as to warm up, and the last few minutes should be at a slow pace for the men to cool off. Always avoid the tendency to the final spurt in nearing evening camp.

The ordinary Marine Corps shirt holds a pint of perspiration, when saturated, this is equivalent to 300 Calories, which energy can be conserved by the simple expedient of slow marching at the end of the day. This permits the moisture to be evaporated on the body during the marching period when the chilling effect serves a useful purpose. The march should be completed with a nearly dry shirt to prevent harmful chilling effect during the following rest and recovery period.

The rate for infantry is 100 yards per minute. To maintain this speed, one hundred and twenty 30-inch steps are required, which gives an actual rate of 3.46 miles per hour (exclusive of rest periods). This may be regarded as the most economical speed for experienced troops. For unseasoned troops and for longer hikes, the economical speed is a slower cadence than the above.

With a speed of 3.46 miles per hour for the day's march, if the rest periods are included, from start to end of the march an average of 2½ miles per hour is considered the maximum expected of foot troops.

Double time is a 36-inch step at the rate of 180 steps per minute, and should never be used in routine marching.

In route step, there is no standard stride or cadence, and the men are out of step, which is often a restful variation.

The marching column varies with route step, marching in time, and marching to music or singing.

Mechanics of marching.—Mathematical calculations show that in marching the best mechanical advantage is obtained by a stride the length of which is six-sevenths the length of the leg. The stride is a pendulum motion.

The "flexion marching" of the French—where it was claimed that men covered long distances at the surprising speed of 6 miles per hour—consists in keeping the knee flexed, and inclining the body forward—a continuous falling forward. This method has been practically abandoned.

The correct position for head and limbs in marching corresponds to the attitude one assumes when about to ascend a flight of stairs.

The proper load for an infantryman should not exceed one-third of body weight or 50 pounds for a 150-pound man. The maximum is 45 percent of body weight or 67 pounds for the average man, and any increase above this 67 pounds causes expenditure of energy to be increased three times as rapidly as the load.

The load should be adjusted near the center of gravity of the body—i. e., in the erect position 0.6 cm front of the line connecting femoral heads and opposite center of third lumbar vertebrae.

The chest or abdomen should not be constricted by the load and the load should be borne by the shoulders and back.

March formation.—If there is much traffic on the road the marching column should keep to the right and proceed in squad formation. If circumstances permit, it is much better to march in open ranks—half on each side of the road, which order tends to decrease the heavy oppressive cloud of dust, foul odor, and water vapor from perspiration which tend to hang over close-order formation.

The taller men at the head of the column are apt to set a pace uncomfortable to the shorter men marching in the rear of the column, and it is also easier marching at the head than in the rear, consequently the column should be reversed from time to time. The rear files as a rule expend about 6 percent more energy than those at the head.

HALTS.—The first halt should be after 30 minutes of hiking, and should be for a period of 12 minutes. The object of the first halt is to permit the men to get their "second wind," adjust shoe laces, rearrange packs, and to attend to the calls of nature. The succeeding halts are made every 50 minutes and are for a period of 10 minutes rest, except the halt for the noon meal, which is for 1 hour.

During the rest periods the men should remove their packs and lie upon their backs. Their coats should be replaced and unbuttoned to avoid undue exposure to drafts and winds. An endeavor should be made to halt in cool shady places, protected from strong winds. A place should be provided for the men to attend to the calls of nature during the rest periods—shallow trenches dug with a bayonet or sharp stick will suffice for this purpose.

Endeavor to select locations for halts that have the following characteristics:

Clean and dry.
Sheltered from the sun.
Privacy.

If practicable avoid halting the column in towns, villages, or near habitations.

Massage and kneading of muscles of legs during halts free the accumulated waste products and prevent stiffness.

In difficult and mountainous country the halt periods should be more frequent.

The order should be given to "remove packs" within 30 seconds after halt—any unnecessary delay irks and irritates the marching organization.

In considering rest periods, the usually accepted practice of seventh day of rest—Sunday—should be adhered to.

LENGTH OF MARCH.—The length of the day's march is not measured by miles, but according to the condition of the roads, the weather, the pace, the weight of the loads, experience and physical condition of the troops, etc.

	Miles per day
Average for large body of infantry	12
Average for small body of infantry	15

Any distance beyond the above is regarded as a forced march.
Wagon trains march about as rapidly as foot troops.
Artillery covers 15 to 20 miles per day.

MORALE.—A fatigued body causes a hypersensitive state of mind, which is more susceptible to real or imaginary adverse stimuli. To inhibit the action of these stimuli calls for resourcefulness and leadership in company officers. One company under proper leadership will arrive in the evening camp, tired but happy, whereas another

company, not so fortunate in the selection of company officers, is apt to come into camp tired and dissatisfied.

Singing and whistling of popular tunes should be encouraged, as this distracts the minds of the men from their fatigued state, and is one of the surest means of preventing them from succumbing to exhaustion.

Straggling, either from poor discipline or fatigue, is always to be avoided, as it is depressing to the morale of the entire body of troops.

Night marching.—Marching at night should be permitted only for strong tactical reasons, as marching at this time interferes with the sleep routine; in the darkness men cannot be sure of their footing and accidents may occur. The deleterious results of night marching are shown by the experiences of French's division in South Africa, where the regiments marching in the daytime were better in health and marched farther than those marching at night.

Marching in the tropics.—In warm countries the march should be started earlier, shortly after daybreak, if practicable. Marching in the middle of the day should be avoided by a midday rest period of 2 to 3 hours.

Green leaves or a wet handkerchief in the hat serve to protect the head and neck from the sun's rays.

It is particularly necessary to open up shirt fronts and roll up sleeves. Tests were conducted on an organization hiking 7 miles with a dry and wet bulb reading 79° F. and 67° F. and the men were found to lose an average of 3 pints of water. But with shirts opened and sleeves rolled up the loss of fluid was reduced from 3 pints to 2 pints in marching the same distance under the same climatic condition.

In warm countries the loss of heat by radiation is generally very rapid after sunset, consequently a fall in body temperature and a chill results if the men are wet with perspiration and not given time to cool off gradually before halting for the night.

An endeavor should be made to detect early appearance of symptoms of heat stroke which frequently occurs during hot weather marches.

The treatment is:

1. Loosen all clothing.
2. Remove patient to shade.
3. Strip to waist.
4. Fan patient.
5. Apply ice bag or cold water freely to head, neck, and spine, and continue until symptoms subside.
6. Restore body chlorides by administering salt.

In the annual maneuvers of a Marine Corps unit at Quantico recently, 26 cases of heat exhaustion occurred 1 afternoon in the combat area. About 10 percent of the unit was incapacitated. This shows what can be expected unless every precaution is taken and rest periods allowed.

Among some of the examples of heat affecting the marching command, the following are cited:

1. On July 8, 1853, about two-thirds of a Belgian regiment was struck down with heat on the march.
2. In 1878, one Austrian regiment had 320 cases and 31 deaths from heat exhaustion while on the march.
3. In one of the French divisions over 2,000 cases of heat prostration occurred.
4. In the forced march on Pekin, a regiment of United States Army—1,200 strength—had one-fourth of its men temporarily disabled from heat, with 8 deaths ensuing.

Water Discipline on the March

In marching one mile a fully equipped soldier generates 90 calories, which will require the evaporation of 180 cc of water to dissipate the heat. For 3 miles, or one hour of hiking, he will require 540 cc of water, which is a little over one pint (473) cc and for two hours of hiking the soldier will lose two pints or the equivalent of one canteen of water.

In interpretation of the above, it must be remembered that the water requirements are based upon the climate of middle and western Europe. In a hotter and drier climate, a larger amount of water should be used.

There are so many factors entering into the water requirements that any attempt to be dogmatic or standardize the fluid intake for the marching soldier is apt to result in more damage than good, if a standard is too rigidly adhered to. It is safe, however, to use the following as a guide, since the soldier starts the march with about 1 pint of extra fluid in his stomach.

Drink one pint, half the contents of the canteen, for each hour of marching, including rest periods, the marcher to take the first drink at the end of the second hour after leaving camp.

Since much of the Marine Corps duties are in the tropics where the hot climate considerably increases the water demands of the infantryman, the above must be increased. Hilly, muddy, and rough roads also increase water demands.

The writer has noted a discrepancy in the articles on water discipline on the march. The articles on this subject are based upon the British authorities who use the term "quart" according to Im-

perial measure, which is about 25 percent larger than the quart—Apothecaries measure.

One quart (Imperial measure) equals 1182.92 cc.
One quart (Apothecaries measure) equals 946.34 cc.

The canteen should be used only during the rest period and then upon command. Water should be slowly sipped as thirst is quenched better. In addition to water consumed from canteens, a pint or more is consumed with each meal.

The experienced soldier has instinctively determined the proper amount of water which his system will require; it is the raw recruit who is apt to "water log" his tissues, sweat profusely, and tire easily.

One type of thirst is due to dryness of the mouth, and to overcome this factor the men are advised to chew gum, or keep pebbles in their mouths, which promote the flow of saliva and tend to allay this form of thirst. Smoking on the march tends to increase thirst and should be limited to rest periods, or, as some authorities recommend, should be prohibited during the march.

As a rule marching troops are accompanied by water carts containing potable water. It is most important that only pure water be used in the canteens, as the stomach of a marching soldier is apt to contain insufficient hydrochloric acid to destroy infective organisms.

The water needs of officers are slightly less than those of men, because their equipment is lighter, and marching to one side requires less work than marching in ranks.

Upon arrival in camp, guards should be stationed over the water supply. Portions of the running stream should be designated for types of water supply, viz—up stream—drinking water—white flag; down stream—watering animals—blue flag; further down stream—washing and bathing—red flag.

	1 hr.		3 hrs. Drinks remaining half canteen		6 hrs.		8 hrs. Drinks remaining half canteen	
0 hrs. Start of march, 1 pt. in stomach.		2 hrs. Drinks ½ canteenful.		4 and 5 hours Noon rest refill canteen, leave camp with 1 pt. in stomach.		7 hrs. Drinks ½ canteenful.		9 hrs. Camp-refill canteen.

Food on March

A light breakfast—consisting of oatmeal, tea or coffee, bread and jam, and perhaps some bacon, "to stick to the ribs." The food should be easily digestible. A heavy breakfast is inadvisable as digestion is interfered with by the vascular demands of muscles used in marching.

Exhaustion retards digestion so that it is well to have a brief interval of rest just before noon and evening meal. The noonday meal should also be light and digestible, and should be served during the noon rest period.

Upon arrival in camp for the evening, serving soup ahead of the meal increases the digestive capacity 20 percent, owing to the stimulation of the flow of gastric juices. The main meal should be the evening meal.

Slowly cooked stew increases the digestibility of proteins.

Foods with high vitamin content such as fruits, vegetables, or even canned tomatoes should be served, because the individual soldier in the field does not have the opportunity of supplementing his ration by outside purchases of food.

Sugar.—In view of its rapidity of digestion and oxidation, is the quickest restorative of muscular energy. A marching man craves sweets, candies, jams, preserves, and sweetened coffee or tea. Chocolate or cocoa are excellent muscular tonics.

	Calories	Foot tons of energy
1 gram protein furnishes	4.1	6.3
1 gram fat furnishes	9.3	14.2
1 gram carbohydrates furnishes	4.1	6.3

From the above table, data are furnished as a basis of calculating the food requirement of the marching man.

The soldier in marching at the rate of 3 miles per hour does work the equivalent to raising one-twentieth part of the weight of the body through the distance he walked.

	Work in tons lifted 1 foot
Marching 1 mile	18.86
Marching 2 miles	37.72
Marching 10 miles	188.60
Marching 20 miles	377.20

If the soldier carries 60 pounds of equipment, the foot-tons are increased 30 percent. Carrying 60 pounds and marching 20 miles the soldier expends the equivalent to 518.60 foot-tons.

Manifestly the caloric requirement of a marching soldier is higher than at rest. A diet of 4,000 to 6,000 calories should be planned, depending on the length of the marches, rate, condition of road, terrain, weight of load carried and other influencing factors.

The use of tobacco and alcohol by marching troops has proponents and opponents. Smoking should be limited to rest periods. Alcoholic beverages should be restricted to the evening after arrival in camp and temperance must be enforced.

March Sanitation

At the start.—

1. Fill and chlorinate water carts—canteens should be filled the night before.
2. Police camp, extinguish camp fires.
3. Fill in, close and mark latrines.
4. Sanitary officer and police detail remain and clear waste and litter.
5. Final inspection of camp site.

Halt.—

1. Designate sanitary area.
2. Dig shallow pits for calls of nature—using bayonet or stick for digging implement.
3. Refill canteens.

Selection of campsite:

Toward the end of the day's march a staff officer, a medical officer, and an engineer officer or a quartermaster should ride forward and select a camp site, unless this has been previously arranged. The functions of the medical officer are advisory in the final selection of camp site. In time of war tactical consideration is of primary importance in the selection of a camp site. It is impracticable to locate an ideal camp site which will be entirely satisfactory from a medical viewpoint, hence the medical officer must consider the pro and contra of the available locations.

1. Favorable considerations:
    - (*a*) Accessibility to a supply of good water, fuel, and forage.
    - (*b*) Sandy loam or gravel soil.
    - (*c*) Elevated site well drained, such as sloping plateau.
    - (*d*) Shade trees as a protection from the sun's rays in warm weather.
    - (*e*) Hills and forests acting as windbreaks in cold weather.
    - (*f*) The location selected should be large enough to accomodate the troops, and crowding should be avoided.
    - (*g*) Grass-covered location.

2. Unfavorable considerations:
   (a) Site recently occupied by other troops, allowing two months' vacancy as an arbitrary standard.
   (b) Dry bed of river, ravines, and base of hill if there is likelihood of rain.
   (c) Clay, alluvial, or dusty soil.
   (d) Proximity to marshes, swamps, and other mosquito-breeding areas.
   (e) Steep slopes.
   (f) Sites where the ground water is near the surface.
   (g) Proximity to native habitations especially in malarial regions.

IN CAMP.—REMEMBER—*Today's campsite may be tomorrow's line of communication.*

1. Proper waste disposal.
2. Insect control.
3. Water inspection.
4. Food inspection.
5. Care of the feet.
6. Do not keep troops waiting in ranks after arrival at destination.
7. Water responsibility:

   Its purity—medical officer.
   Quantity and delivery—engineer officer.
   Procurement—quartermaster.
   Water guards and distribution—unit commander.

MEDICAL DEPARTMENT ON THE MARCH

Before starting, the responsible surgeon should see that all sick and unfit are eliminated and that the campsite is left in a sanitary condition. See that the quality of water in the canteens is satisfactory and that foot disorders have been given the requisite attention.

THE BRIGADE SURGEON.—The brigade surgeon proceeds forward on the staff of the brigade commander. (See fig. 14.)

THE REGIMENTAL SURGEON.—The regimental surgeon occupies a corresponding place in the regiment to the above, and the assistant regimental surgeon marches in the rear of the headquarters company.

THE BATTALION SURGEON.—The battalion surgeon proceeds with the staff of the battalion commander, and the assistant battalion surgeon marches in the rear of the battalion. If there is only one surgeon assigned to a battalion, he should march in the rear of the unit.

The junior medical officers marching in the rear should occasionally proceed up and down the marching column of their respective organizations to observe the condition of the troops.

Soldiers suffering from the effects of fatigue may be dropped at the march collecting stations, ride in ambulances, or they may be

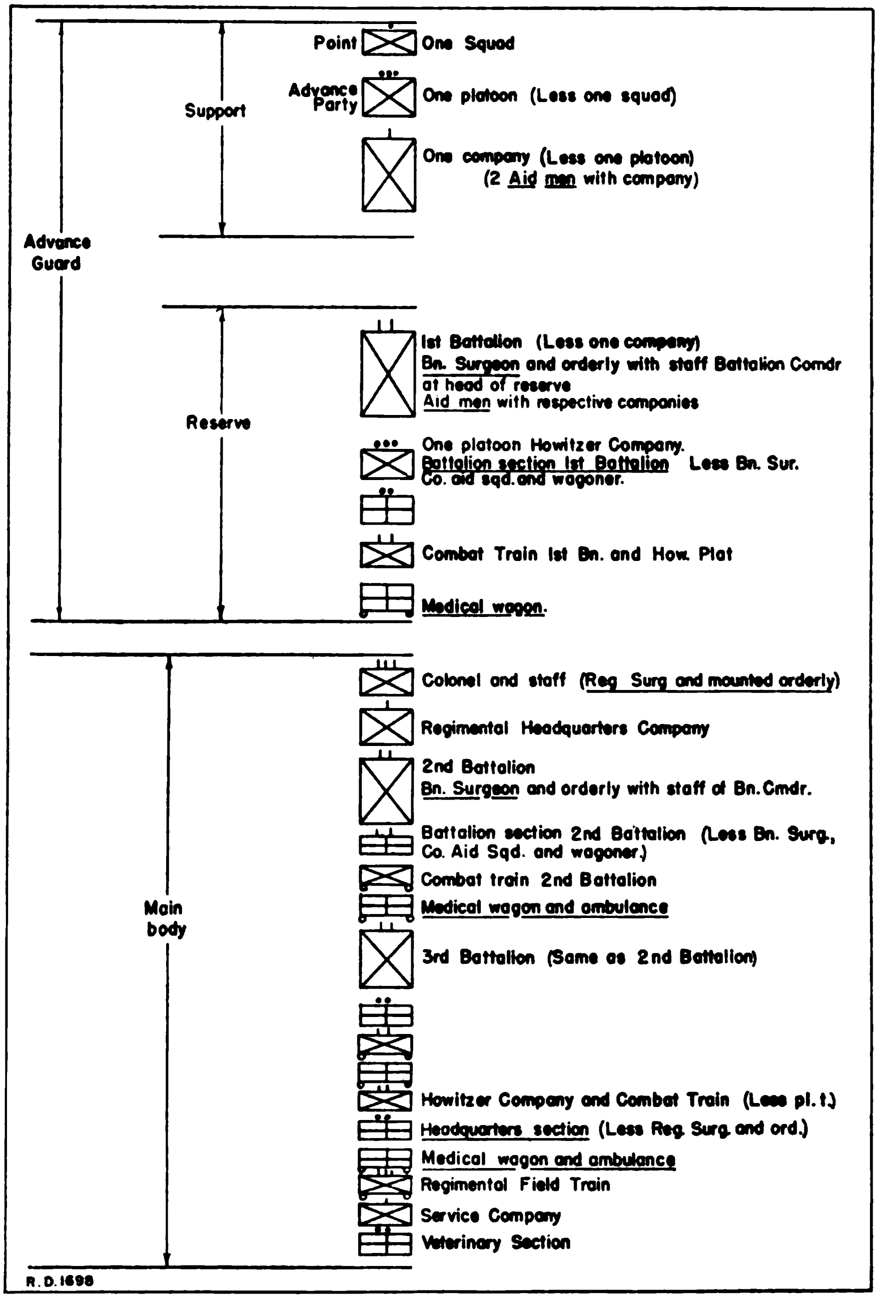

FIGURE 14.—Regimental Medical Department. Distribution of regimental Medical Department on the march. (Military Medical Manual, U. S. Army) Reproduced by permission of the copyright owners, The Military Service Publishing Company, Pittsburgh, Pa.

allowed to proceed without their equipment—their equipment may be thrown upon one of the wagons of the train. All sick and injured patients should be properly tagged with the diagnosis tag and re-

corded. A compilation of these records is made at the end of the day's march.

THE MEDICAL BATTALION.—The medical battalion will proceed in two groups—one consisting of the mounted and foot group, which will march in advance of the animal-drawn train, and the other, consisting of the motor-drawn group, which will proceed at the head of the motorized train of the brigade.

MARCH COLLECTING STATIONS.—If the marching command is composed of a brigade or larger organization, it is advisable to establish march collecting stations every 3 miles. The personnel for these stations consists of two or more hospital corpsmen, who are equipped to give first-aid treatment to the sick, injured, and exhausted, and to retain the patients until they are picked up by the ambulances in the rear of the column.

The hospital corpsmen detailed for the purpose of establishing march collecting stations should proceed with the head of the column or advance party and drop off every 3 miles to form collecting stations. They remain until the tail of the column has cleared their station, then fall in with the rear units.

Towards the end of the day's march the necessary sanitary personnel should join the advance guard to supervise water purification and make arrangements for sanitation before the main body arrives.

Combatant units of advance guards, rear guards, and other security detachments are normally accompanied by their attached medical troops.

POISON IVY.—In view of the fact that poison ivy is a source of danger to a marching command, detailed consideration is advisable. In one of the maneuvers of the United States Marine Corps ivy poisoning caused many sick days and some of the recruits present had the misfortune to use this bush as toilet paper, with rather serious results.

Ivy poisoning is a form of dermatitis venenata due to exposure to poison ivy (Rhus toxicodendron), and the excitant is an oily compound called toxicodendrol, belonging to the phenol group. As little as 0.001 mgm of toxicodendrol may produce dermatitis. All parts of poison ivy contain the irritating principle, the leaf especially.

Poison ivy grows as a woody vine, trailing shrub, or erect bush, growing in the woods or in the open, in moist or dry soil. It climbs trees and posts.

The plant is recognized by its leaves which are divided into three leaflets; and by its white mistletoe berries, known as drupes; the latter remain on the plants into winter after the leaves have fallen. All of these plants do not bear the drupes and it must be recognized by the leaves.

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The leaves are from 1 to 4 inches long. The end leaflet of the triad has a longer stem than the two opposite leaflets, which, as the leaves are broad, though pointed, preserves the symmetry of the arrangement.

The mature leaves are dark green on the upper surface and lighter underneath. The crinkly young leaves are red when they first unfold, becoming green later. In autumn they turn to beautiful shades of scarlet and orange. The innocent sometimes pluck these leaves and to their sorrow bear them off.

The old adage runs—"Leaflets three, let it be"—makes a safe rule for those of us who perhaps have neglected "How to know the wild flowers."

Babies are not susceptible to poison ivy until they are sensitized by sufficient contact.

The period of incubation, after contact in the susceptible, is usually a few hours but may be delayed for days. Redness and erythema appear, usually first on the face and hands. Shortly, fine vesicles, clear and closely grouped, are observed in the thinner areas, such as the inner surface of the fingers. Other areas of skin become affected, even those where there has been no direct contact. The eyelids and surrounding tissues are frequently greatly swollen. Probably by indirect contact the genitals become edematous and the rash has a predilection for the looser and thinner skin.

As the active agent is fat and alcohol soluble, the irritant may be largely removed if immediately after exposure the areas are washed with soap and water. Alcohol or ether, used on swabs, being careful to clean the irritated areas from the periphery towards the center, is a more effective measure.

Two readily available agents are recommended for the treatment of the lesions.

1. Potassium permanganate in a 5-percent solution in water, applied locally by cotton swabs or cloths; frequent applications should be made, or if a dressing is used, frequent changes of the dressing.

2. Chloride of iron, a 5-percent solution in equal parts of alcohol and water can be used in the same way.

THE FOOT

Anatomy and Physiology

The human foot is a specialized organ designed to promote terrestial locomotion of the individual by leverage action of the foot in lifting the body's weight and it plays such a dominant role in marching that a brief description is appropriate.

Considered in its entirety, the human foot is indeed a very wonderful anatomic part of the individual. In the smallness of its size and

weight, out of all proportion to the burden borne and carried, it constitutes a mobile, strong, flexible, and efficient member of the organism designed to bear weight forwards, backwards, and sideways without mishap. Encased in a cloth covering, the sock, and in a protective leather covering, the shoe, both concomitants of an advancing and exacting civilization, this member, the most unintentionally neglected part of the body is expected to do its full duty.

The foot is composed of a nicely adjusted aggregation of 26 bones of various sizes and shapes, each, however, designed to perform a certain definite function. Seven of these are of a very irregular shape

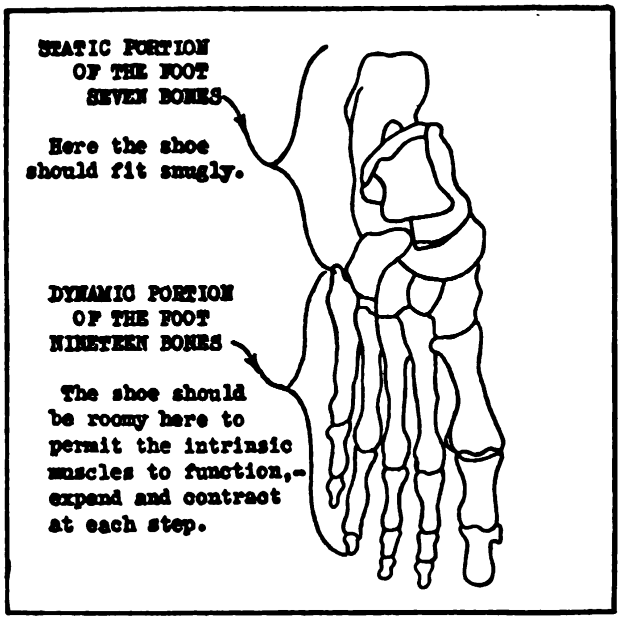

FIGURE 15.—Bones of the foot.

and are located in the hind part of the structure forming the heel and a portion of the so-called instep. The remaining 19, situated in the forepart of the foot, form a portion of and radiate fan-like from the instep. These extend forward and to the outer and inner sides, finally ending in the toes. These different bones are held together in a correct position by ligaments, tendons, and muscles; the ligamentous support predominating in the posterior 7 bones which form the static portion of the foot, while muscular action predominates in the anterior 19 bones which form the dynamic portion. (See fig. 15.)

The posterior seven bones, forming a compact mass held by ligamentous attachments, move very slightly when a step is taken and serve to minimize the shock of impact and act as a recoil mechanism. On this mass—the static portion of the foot—in the shod man, all the weight of locomotion is first borne; first affecting the heel and center of the instep.

The anterior 19 bones are controlled mainly by muscular action—the dynamic portion—and when in use bearing weight move extensively. From the center of the instep the weight borne is shifted to the ball of the foot which spreads medially and laterally presenting an enlarged area to the walking medium. The toes also spread laterally, medially, and lengthen, gripping the surface.

The anterior of the human foot is composed of many tiny muscles, many sensory and motor nerves, and tendons. Over the dorsum or upper surface of the foot the muscles are few in number and lacking in development. However, on the plantar or lower surface, filling the arch beneath the instep there are five layers of well-developed muscles which buttress the arch, preventing descent of the latter

FIGURE 16.—A "figure of eight strap" military shoe devised by the writer.

when continued and excessive weight is borne. These muscles expand and contract in each step of the marching soldier. A shoe which fits the anterior part of the foot too snugly causes pressure on nerves and muscles, and prevents the muscle from functioning and causes them to atrophy—weaken and shrink. The shoe shown in figure 16, fits the static portion of the foot snugly and at the same time it allows the intrinsic muscles in dynamic portion of the foot to expand and contract at each step.

The posterior portion has very few muscles, tendons, or muscular nerves. The "after" portion of the shoe should fit the foot snugly—as does the United States Marine Corps pattern of shoe.

The longitudinal arch, on the inner surface of the foot extends from the heel bone (Os Calcis) to the distal end of the first metatarsal bone. This is definitely formed by the inherent structural

concavity of the bones held among themselves by ligaments and supported from below by developed muscle layers.

The anterior arch is formed by the distal ends of the metatarsal bones. The muscular development concerned in sustaining this arch is not so great as in the longitudinal.

A tripod is formed by the structure of the foot; the apex of which is the highest point of the heel bone (Os Calcis), the inner side of the ball of the foot at the base of the big toe (distal end of first metatarsal bone) and the outer side of the ball of the foot at the base of the little toe (distal end of the fifth metatarsal bone).

The lifting force is exerted at the heel, H; the body's weight, W, is superimposed at a position corresponding to that of the ankle; and the lower corner of the opposite end is employed as a fulcrum, F, representing the position of the heads of the first and second metatarsal bones. When H is lifted, the force passing through the substance of the block is directed upward and forward in a curved direction toward the W; from there it curves forward and downward upon the fulcrum.

As before mentioned in this chapter, the center of gravity of the body must be considered in the carrying of extra equipment. When the soldier is standing, stance, stable, or static equilibrium is involved as the center of gravity is directly above the feet which act as a support.

When locomotion is started as in marching, dynamic equilibrum is brought into force by an active interplay between the organic energy of the soldier and the force of gravity. The feet function as a series of levers that act against the body's center. In marching the body's center is constantly being displaced forward, and gravity thus assists the forward translatinal motion through its influence upon the unbalanced body weight. The walking man, so to speak, tends to fall forward at each step, until this action is interrupted temporarily and the body is balanced momentarily by one foot as a support. The marching soldier always has one foot on the ground.

Man, more often than any other animal, in upright bipedism, makes better use of gravity as an auxiliary force in locomotion.

A comparison of the feet of the shod man and the bare footed savage is interesting and instructive. In the shod man the joints are not as flexible, the muscles are not as well developed and the toes in walking do not spread and grip; being limited by the shoe. Taking a step he strikes the heel first, shifts the weight to the outer border of the foot, then full upon the ball while the toes, as above explained, are limited in their motion. In that the shoes limit the bearing surface of his feet he toes out sometimes slightly, other times excessively, to preserve his equilibrium, thus throwing the

weight borne backward on the inner border of the foot—on the arch—where it should not all be borne.

On the other hand, the savage has very flexible joints, well developed muscles under the arch as are also the muscles of the calf of the leg. In locomotion he has his feet parallel—the correct posture—or toes in throwing the weight upon the ball of the foot, center of the instep and outer border of the foot. His toes, unhampered by a covering, spread widely, lengthen, grip the surface, and thrust vigorously backwards. He walks on soft, nonresistant earth which conforms itself to the irregularities of the foot forming an accurate impression which lessens strain on the muscles and ligaments and minimizes the shock of impact. The reverse is true in the civilized individual who, his feet encased and limited in motion by a covering, the bottom of which does not conform to the irregularities of the foot, walks the greater part of his life on macadamized roads or rock pavements where muscle strain and shock of impact are great. (From Foot Care and Shoe Fitting by Mann and Folsom.)

Care of the Feet

Shoes.—According to the Duke of Wellington, the three most important parts of a soldier's equipment are a pair of good shoes, a second pair of good shoes, and a pair of half soles.

New shoes should not be worn on the march unless they have been broken in. An excellent method of adapting new shoes to the foot consists in the soldier standing in his shoes in 2 inches of water for 5 minutes. This makes the leather soft and pliable. The man then walks on level surface about an hour, and the pressure of the body weight causes the drying leather to conform to the shape of the feet. This scheme accomplishes in an hour what a week of ordinary "breaking in" can produce.

Socks.—Light woolen socks in summer time, and heavy woolen ones in winter, are preferable over cotton fabric.

Socks too large will form folds and thus cause pressure foot injuries and if too small tend to produce ingrowing toenails, hallux valgus, and clubbed toes. Refer to subjoined tables for proper sizes to be worn with the required length of shoe.

Turning socks wrong side outwards, and changing socks from one foot to another equalizes wear, and is conducive to comfort. Holes in socks are apt to cause blisters as the edges of the hole tend to curl and cause pressure damage upon the subjacent skin area. Avoid using darned socks.

The life of a good light-wool sock is about 100 road miles, but if feet are wet the sock will wear through much sooner.

It is interesting to note that the Spanish, French, and Italian Armies do not wear socks. (Blackham.)

Socks should not be colored with analine or other irritating dyes which wash out with perspiration, hence the regulation grey is a good color.

Ribbed socks are better than plain ones, as they are more elastic and fit the foot better.

Shoe Size:	Corresponding sock size
5–5½	10
6–6½–7	10½
7½–8–8½	11
9–9½–10	11½
10½–11–11½	12
12–12½–13	12½
13½–14–14½	13
15	13½

Some soldiers grease their socks or rub the feet with candle, vaseline, or unsalted pork, and thus lessen the friction between foot and sock.

New socks should be washed and shrunk before use for marching purpose.

A series of tests were conducted at Marine Barracks, Quantico, Va., on the shrinking of Marine Corps issue socks. Heavy woolen, light woolen, and cotton socks each were washed three times at same temperature. Three temperatures were used 212°, 200°, and 75° F. respectively. Ivory soap was used. The greatest amount of shrinkability and lost elasticity was found in the heavy woolen socks. After the first washing at 212° F. and immersion for 15 minutes, shrinking of 1 inch in height, 1 inch in width, and 1½ inches in length were noted. Second and third washings at 212° F. caused a further shrinkage 1 inch in height, one-half inch in width, and one-half inch in length. Total shrinkage after three washings at 212° F. as follows:

	Inches
Height (from heel to top of sock leg)	2
Width	1.5
Length	2

Total loss of elasticity noted as follows:

	Inches
Height (from heel to top of sock)	3
Width	2
Length	2.5

Washing and immersion in temperatures 200° and 75° F. caused very little shrinkage and loss of elasticity. Boiling seems to play a great part in the production of shrinkage and lost elasticity.

In the light woolen socks after three washings each in the different temperatures as given above there was total shrinkage noted as follows:

	Inches
Height (from heel to top of sock leg)	0.5
Width	1
Length	1.2

Total loss of elasticity noted as follows:

	Inches
Height (from heel to top of sock leg)	1
Width	1.5
Length	2.3

The total amount of shrinkage and lost elasticity in the cotton socks after three washings and immersions at each temperature were very inconsiderable and not worthy of note.

1. Upon arrival in camp, remove shoes, clean, dry, and dubbin them.

2. Wash feet in cold water to tone foot muscles. Foot inspection by company commanders.

3. If feet are tender bathe in alcohol or 1 percent formalin solution, or 2 percent alcoholic solution of salicylic acid, or 10 percent picric acid solution.

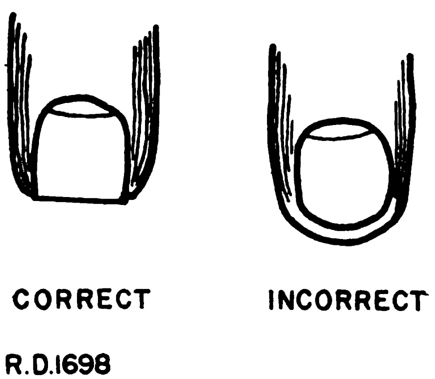

FIGURE 17.—Showing the correct and incorrect method of cutting the nails of the toe in order to prevent ingrowing toe nails. When the nails are cut at right angles, the flesh is less likely to grow around the edges. (Foot care and Shoe Fitting, Mann and Folsom.)

4. Put on clean socks and shoes.

5. Wash and knead soiled socks for use next day.

6. Trim toe nails square, so as to prevent ingrowing toe nails. Another method of prevention of ingrowing toe nails consists of scraping the upper surface of the toe nail in center. This causes the nail to be thinner in center and leads to eversion of the outer sides of the growing nail. This method is practised in certain rural sections of this country and is claimed to be an effective prophylaxis. (See fig. 17.)

TREATMENT OF FOOT DISORDERS.—Puncture blisters at dependent portions of base—using sterile needle—remove serum and paint with tincture of iodine. Cover blister with adhesive tape with small hole in center to allow discharge to escape.

For smelly feet (bromidrosis) use 2 percent solution of formalin or apply 2 percent salicylic acid ointment.

Pare corns with curved scissors after treatment with:

Salicylic acid	grains	60
Ext. canabis indica	do	8
Collodium flexible	ounce	1

A small amount of alcohol to preserve above mixture can be added.

Corn salve consists of:	*Parts*
Salicylic acid	40
Vaseline	30
Lanolin	30

It is an old trick of the soldier to lessen friction between socks and foot by soaping the inside of the sock, so that perspiration of the foot works a lather which serves as a lubricant. Another means of minimizing the shoe rubbing the foot is to wear two socks on each foot.

In cold weather, when there is less perspiration, dust foot powder inside the sock to minimize friction. This foot powder is issued by the Quartermaster.

	Parts
Talc (mg silicate)	87
Boric acid	10
Salicylic acid	3

The French figure of eight strap can be used to lessen friction so that a man with blistered feet can often march in comfort. It is said that foot injuries tend to heal more rapidly when marching than at rest, because the increased blood supply to marching feet causes healing to occur more promptly.

In some experienced organizations, sore feet are reckoned as a military offense both for the individual and for his company commander.

The *pied forcé* of the French is a fracture of the second or third metatarsal bone at the junction of the anterior and middle thirds. It occurs in marching with heavy load, especially in double-time.

A short first metatarsal bone causes the second metatarsal to act as the principal leverage member. The stresses converge upon the base of the latter only, being transmitted by it to the ground. Under the increased amount of function, the second metatarsal becomes widened and hypertrophied; a correspondingly increased strain is imposed upon its basal joint.

POINTS TO BE CONSIDERED IN SANITARY INSPECTIONS[4]

1. MESS HALL.—

Is it screened?

Are flies present? What measures are taken for fly prevention?

[4] From Essentials of Field Sanitation, U. S. Army Field Medical Service School.

Are mess tables scrubbed after each meal?
Are tables so constructed that center boards can be removed for cleaning?
Are food particles found between boards on tables?
Is floor clean? What method of cleaning is used to prevent dust?
Are mess attendants clean as to person and clothing?
Are dishes and tableware clean and free from grease?
What provisions are made for washing dishes? Is soapy water and rinse water boiling at the time the dishes are washed?

2. Kitchen.—

Is it screened?
Are flies or roaches present? What insect control measures are used?
Are work tables and meat cutting blocks scrubbed after using?
Is menu posted? Is diet varied? Is it well balanced?
Is food served in an appetizing manner?
Is hot food served hot?
Is cold food served cold?
Are kitchen utensils free from grease?
What provisions are made for washing pots and pans? Is rinse water boiling at the time pots and pans are washed?
Is provision made for mess personnel to wash their hands after using the latrine?
How is garbage handled in the kitchen?
Is floor kept clean? What method of cleaning is used to prevent dust?
Are the food handlers examined according to regulations?
Is the food handlers list posted in kitchen?

3. Garbage disposal.—

Is garbage rack clean? Are food particles found on rack or on the ground under and around the rack?
Do lids fit tightly on garbage cans?
Are garbage cans properly cleaned after emptying?
Are fly traps being used at the garbage rack? Are they properly baited?
What system of garbage disposal is used?
    If by incineration is the incinerator kept clean?
    Is the area around the incinerator kept clean?
What method of disposal is made of liquid wastes?

Is the grease trap kept clean?
Is the soakage pit adequate?
Are cans burned and flattened out before being placed on dump?

4 Food storage.—

Is ice box temperature at 45° or cooler?
Is the ice box or cooler clean? If a cooler house is used is it screened?
Is meat suspended so that there is circulation of air on all sides?
Is cured meat stored so that there is free circulation of air on all sides?
Are vegetables stored in bins off the floor with free circulation of air on all sides?
Are the bins clean and is the floor under the bins clean?
Is milk supplied in bottles?
Is milk kept at the proper temperature?

5 Water supply.—

Is water source properly protected from contamination?
Is the method of chlorination properly supervised?
Is the water chlorinated satisfactorily?
Is the water examined bacteriologically at frequent intervals?
Is the water free from objectionable color, odor, and taste?

6. Showers.—

Are there sufficient shower heads?
Is hot water available?
Are duck boards used? Are they scrubbed daily?
Is shower room kept clean?
Are benches available for undressing?
What provision is made for prevention of spread of skin infections?

7. Latrines.—

Are latrines screened if not enclosed in building?
Are latrines sprayed daily?
Are seats and urinals scrubbed daily?
Are lids kept closed at all times?
Is the latrine fly-proof?
Is the latrine floor clean?
If water carriage system of sewage disposal is used, are flush boxes and toilets all in working order?
What system of disposal of sewage is used?

If septic tank, is it adequate?
What method of disposal of effluent is used?
If tile field, is there evidence of over-charging the field?
If by dilution, is the stream flow or other body of water adequate at all times for proper dilution?

8. Barracks.—

Are barracks well lighted?
Are drafts noticeable?
Is ventilation adequate?
Are floors clean? What method of cleaning is used to prevent dust?
Is floor space adequate for the number of men in the building?
Is heating adequate and uniform throughout the rooms?
Are heat deflectors used in disseminating the heat if stoves are used?
Are beds or bunks free from bed bugs?
Is bed clothing clean?
Is bedding aired twice a week?

NAVAL RESERVE

PROMOTIONS, FIRST QUARTER, 1938

Henry Amiss Hornthal, 21 Massachusetts Avenue NW., Washington, D. C., promoted to lieutenant, MC–F., U. S. N. R., February 1, 1938.

James Edward Wilson, 2075 Madison Avenue, Memphis, Tenn., promoted to lieutenant, MC–V (G), U. S. N. R., February 1, 1938.

Albert Louis Bork, 8734 W. National Avenue, West Allis, Wis., promoted to lieutenant, MC–V (G), U. S. N. R., March 4, 1938.

Asa Glenn Churchill, 1300 Orange Avenue, Coronado, Calif., promoted to lieutenant commander, MC–F., U. S. N. R., March 4, 1938.

Edward Thomas Gary, U. S. Veterans' Facility, Togus, Maine, promoted to lieutenant, MC–V (G), U. S. N. R., March 4, 1938.

Benjamin Bernhardt Kies, C. C. C. Camp, Wetumka, Oklahoma, promoted to lieutenant, MC–V (G), U. S. N. R., March 4, 1938.

RESIGNATIONS, FIRST QUARTER, 1938

Rudolph E. Swenson, 2 North Street, Plymouth, Mass., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted January 12, 1938.

Harve M. Clodfelter, 683 East Broad Street, Columbus, Ohio, lieutenant, MC–V (S), U. S. N. R., resignation accepted January 19, 1938.

William L. Cruchett, 858 Ensenada Avenue, Berkeley, Calif., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted January 26, 1938.

Joseph A. D'Allessio, 3 West Carrillo Street, Santa Barbara, Calif., lieutenant, junior grade, MC–F., U. S. N. R., resignation accepted January 26, 1938.

Herbert Fay H. Jones, 808–815 Donaghey Building, Little Rock, Ark., lieutenant, MC–V (S), U. S. N. R., resignation accepted January 26, 1938.

William L. Weber, 924 Pacific Electric Building, Los Angeles, Calif., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted January 26, 1938.

William J. Kebler, 82 Clinton Street, Tonawanda, N. Y., lieutenant, MC–V (S), U. S. N. R., resignation accepted January 27, 1938.

Ross Sutherland, 617 West Seventh Street, Los Angeles, Calif., lieutenant, MC–V (S), U. S. N. R., resignation accepted February 2, 1938.

John Paul Medelman, 572 Lowry Medical Building, St. Paul, Minn., lieutenant, junior grade, MC–V (S), U. S. N. R., resignation accepted February 17, 1938.

Joseph Fulcher, 210 Medical Arts Building, Tulsa, Okla., lieutenant, MC–V (G), U. S. N. R., resignation accepted February 17, 1938.

Thayer Lemoyne Parry, 1007 Second National Building, Akron, Ohio, lieutenant, MC–V (S), U. S. N. R., resignation accepted March 9, 1938.

Frederick Arnold Lowe, 1222 Vanderbilt Avenue, Niagara Falls, N. Y., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted March 9, 1938.

William B. Steen, Desert Sanitorium, Tucson, Ariz., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted March 9, 1938.

Everett Edward Kelly, 636 Church Street, Evanston, Ill., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted March 15, 1938.

HONORABLE DISCHARGES, FIRST QUARTER, 1938

Wells C. Cook, 1930 Wilshire Boulevard, Los Angeles, Calif., lieutenant, junior grade, MC–V (G), U. S. N. R., honorably discharged January 12, 1938.

HONORARY RETIRED LIST, FIRST QUARTER, 1938

Clifford E. Henry, 523 LaSalle Building, Minneapolis, Minn., captain, MC–V (S), U. S. N. R., transferred to Honorary Retired List January 1, 1938.

Knud Knud-Hansen, Municipal Hospital, St. Thomas, V. I., lieutenant commander, MC–V (S), U. S. N. R., transferred to honorary retired list March 1, 1938.

CHARLES FRANCIS STOKES.
Surgeon General, United States Navy, 1910-14.

NOTES AND COMMENTS

CHARLES FRANCIS STOKES

By Louis H. Roddis, Commander, Medical Corps, United States Navy

The fourteenth Surgeon General, United States Navy, and the eighteenth Chief of the Bureau of Medicine and Surgery, was born in Brooklyn, N. Y., on February 20, 1863. He received his medical degree from the College of Physicians and Surgeons, New York, in 1884, and was an interne at Bellevue and the first house surgeon of the newly erected Gouverneur Hospital. He was appointed from New York as an assistant surgeon of the Navy on February 1, 1889, his commission being signed by President Grover Cleveland. His first duty was on the U. S. S. *Minnesota*, then the receiving ship at the Navy Yard, New York. He then served in the Naval Hospital, Mare Island, Calif., and subsequently at the Naval Hospital, Yokohama, Japan. During the Spanish-American War he was operating surgeon on the U. S. S. *Solace*, the new hospital ship, and the first of our hospital ships to fly the Red Cross flag. He then served as professor of surgery at the Naval Medical School, Washington, D. C. During the cruise of the Atlantic Fleet around the world in 1908, he commanded the U. S. S. *Relief*. He was appointed by President Taft as Surgeon General of the Navy on February 5, 1910, and held office until February 6, 1914. He was widely known as a skillful surgeon and is remembered in the Navy today by the Stokes stretcher which was devised by him. This stretcher has proved of remarkable value in the transportation of sick and injured up and down the narrow ladders and through small manholes and hatches on board ship, and such inaccessible places as firerooms, fighting tops, and turrets. In it a patient can be lowered into a boat in comfort and safety. By simple and ingenious fittings the stretcher was made to combine splinting for fractures with the function of a litter for transportation. This stretcher gave the Navy many advantages in the transport of patients, and has been copied in foreign navies. There is an interesting story in regard to this stretcher and its inventor. Doctor Stokes, who had retired in June 1917, was, in 1926, visiting the display of naval medicine in the exhibits of the American Medical Association held in Washington, D. C. He manifested much interest in the Stokes stretcher, and the polite and effi-

cient hospital corpsman on duty with the exhibit explained the stretcher and its uses at great length. Admiral Stitt, then Surgeon General, came up at that time and greeted the former Surgeon General, and the hospital corpsman found that he had been explaining the stretcher to its inventor. Stokes praised the corpsman for his knowledge of the stretcher and its uses, telling Admiral Stitt that he hoped all members of the Medical Department were as well acquainted with its use.

Surgeon General Stokes carried on the work begun by Rixey directed toward improvement of the efficiency of the Medical Department of the Navy. High standards were maintained for entrance into the Medical Corps, and only candidates who were graduates from excellent medical schools and capable of passing rigid physical and professional examinations were accepted for commission. The newly instituted Hospital Corps School at Norfolk was utilized to the utmost in the training of the Hospital Corps and most of the chief pharmacists of the Navy for many years were graduates of this school. Honolulu and the Hawaiian Islands were being recognized as a strategic center of prime importance, and in connection with the development of naval facilities there, the United States Naval Hospital, Pearl Harbor, was planned and built during Stokes' administration of the Bureau. As the former commanding officer of the hospital ship, Admiral Stokes had great interest in these vessels, and plans were made in his regime for additions to these important auxiliary craft, which later materialized in the hospital ships *Mercy* and *Relief*. The latter was the first vessel of a modern navy to be designed and laid down as a hospital ship, previous vessels of this class having been converted from liners.

After retirement, Admiral Stokes lived in New York City until his death, which occurred October 29, 1931, in his sixty-eighth year. As may be seen from the portrait accompanying this sketch, this Surgeon General was a remarkably fine-looking man and was often referred to as "the handsomest man in the Navy." The picture shows also the old special full-dress coat well known to older officers, but which has not been worn since the World War.

YELLOW FEVER

For some time the Rockefeller Foundation has been investigating the jungle variety of yellow fever. The Aedes is known to be an intermediate host of this disease but the definitive host is still unknown. The disease thrives in a warm humid climate such as the summer season in Brazil where at present it has assumed serious proportions.

During the 2-month period from approximately mid-January to mid-March 120 deaths in Brazil were definitely attributed to this disease. This would indicate that for the present season both morbidity rate and mortality rate (5 percent for 1937) will exceed those for last season. The disease in present cases is contracted in the jungle and there have been no proven cases of cross-infection within the urban population. It also differs from former epidemics of yellow fever in the lower mortality rate.

To date the urban population has been free from attack and appears comparatively safe. The Rockefeller Foundation has developed a new type of vaccine that is stated to confer immunity for life and its agency in Brazil is promoting an active campaign of prophylactic inoculations.

Due to present means of rapid transit and to presence of the yellow fever vector within our borders this outbreak is a public health problem of serious concern to our own services.

OBSERVATIONS ON BURNS DUE TO EXPLOSION[1]

The authors relate their experiences with the casualties sustained in H. M. S. *Hunter* and the German battleship *Deutschland.* The former struck a mine near Almeria on May 17, 1937, sustaining a large number of casualties, and the latter was struck by two aeroplane bombs while lying at anchor on May 29, 1937.

A total of 20 cases was admitted from the *Hunter*, and 55 from the *Deutschland.* Twenty-four to forty-eight hours had elapsed before the patients were admitted to the hospital.

They concluded that explosive, infected burns are unsuited for treatment with tannic acid, and suggest the first-aid treatment of burns with dry dressings. This prevents extraneous infection and presents for debridement a burn which has not been covered with oily substances or chemicals. The bandage impregnated with bismuth, carried by the German ships, was found to be worst of all methods tried. They preferred the vaseline and eucalyptus oil dressing, applied after debridement under gas-oxygen anesthesia.

COMMENDATION[2]

On March 22, 1938, Horace Albert Thomson, Ph. M. 2c., U. S. N., Puget Sound Navy Yard, was commended by the Secretary of the Navy for his action on the occasion of the wounding of His British Majesty's Ambassador to China. Sir Hughe Montgomery Knatch-

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[1] Anderson, C. B. C., and Douglas, J. P., Journal Royal Army Medical Corps, 70: 168, March 1938.

[2] Bureau of Navigation Bulletin No. 260, April 23, 1938.

bull-Hugessen, K. C. M. G., was struck by a machine-gun bullet from a Japanese plane while motoring from Nanking to Shanghai on August 26, 1937. Thomson, on duty with the Fourth Marines, volunteered and donated blood for a transfusion which undoubtedly contributed to the Ambassador's recovery. Such prompt and generous action is in keeping with the best traditions of the naval service.

THE NEW YORK ACADEMY OF MEDICINE GRADUATE FORTNIGHT

The New York Academy of Medicine will hold its Eleventh Annual Graduate Fortnight from October 24 to November 4, 1938. The purpose of the Fortnight is to make a complete study and authoritative presentation of a subject of outstanding importance in the practice of medicine and surgery. All members of the medical profession are eligible for registration.

The subject of this year's Fortnight is Diseases of the Blood and Blood-Forming Organs. The carefully integrated program will include clinics and clinical demonstrations, evening addresses, and appropriate exhibits. Twenty-three hospitals have accepted the invitation to participate by having prepared afternoon clinics and clinical demonstrations which will be coordinated with the evening meetings. The evening sessions at the Academy will be addressed by recognized authorities in their special fields, drawn from leading medical centers of the United States. There will be a comprehensive exhibit of books, pathological and research material, diagnosis, treatment, and prevention whenever possible, clinical and laboratory diagnostic methods, X-rays, action of drugs and other therapeutic measures. Demonstrations will be held at regular intervals.

Among the main features to be presented at the meetings, in the clinics and in the exhibit, will be—

Pernicious anemia.
Other macrocytic anemias.
Idiopathic hypochromic anemias.
Other anemias benefited by iron therapy.
Anemias of pregnancy.
Aplastic and hemolytic anemias.
The granulocytopenias.
Formation and fate of the blood cells.
The reticulo-endothelial system.
Diagnostic significance of changes in erythrocytes.
Diagnostic significance of changes in leucocytes.
Infectious mononucleosis.
The leukemias.
Hodgkin's disease.
Lymphomatoid diseases (other neoplastic diseases of the lymphnodes and bone marrow)
The polycythemias.
Diseases of the blood in infancy and childhood.
The blood clotting mechanism.
The purpuras.
The splenomegalies—their differential diagnosis—indications and results of splenectomy, etc.
Irradiation therapy in the blood diseases.

It is suggested that medical officers desiring to attend this Fortnight make official request to the Bureau for authorization and

credit for attendance. The Bureau can provide no relief for applicants and can authorize no funds other than registration fees.

THE AMERICAN BOARD OF RADIOLOGY[8]

At the annual meeting of the American Board of Radiology, held in Atlantic City, June 1937, the following requirements and recommendations as to professional training were adopted with the purpose of outlining the method or methods which are recommended for graduate training in radiology. The specific requirements to which the Board of Radiology is committed at present are:

1. Professional education:
   (a) Graduation from a medical school of the United States or Canada, recognized by the Council on Medical Education and Hospitals of the American Medical Association.
   (b) Completion of an interneship of not less than 1 year in a hospital approved by the same council.
   (c) Three years' training in radiology or sufficient experience in lieu thereof.
2. Special training (to be effective after January 1, 1940):
   (a) A period of study after the interneship of not less than 3 years in an institution or radiological department recognized by the same council and the Board of Radiology as competent to provide a satisfactory training in the field of radiology, or equivalent training acceptable to the board.
   (b) This period of specialized preparation shall include:
      (1) Graduate training in pathologic anatomy, radiophysics, and radiobiology;
      (2) An active experience of not less than 24 months in a radiological department recognized by the board and the council as capable of providing satisfactory training;
      (3) Examination in the basic sciences of radiology as well as in the clinical aspects thereof.

In case of an applicant whose training has been received outside of the United States and Canada, the credentials must be satisfactory to the advisory board for medical specialties.

AMERICAN COLLEGE OF HOSPITAL ADMINISTRATORS

The Bureau is in receipt of the 1938 Directory of the American College of Hospital Administrators, and a letter from its executive secretary relative to membership in this organization.

Among the objectives of this organization are to provide, through various classes of membership, opportunities for enlarging their knowledge in the field of hospital administration for individuals who desire to follow careers in this field of special service and to provide through the conferring of fellowships for the recognition

[8] Radiology, 29: 734, 1937.

of individuals who have done or are doing noteworthy service in the field of hospital administration.

Membership

In order to qualify for election as a member the candidate must submit evidence of having had 5 years of successful experience as a hospital administrator. At the time of election the candidate must be the chief administrative officer of a hospital of not less than 50 beds, or the assistant administrative officer of a hospital of not less than 200 beds.

The hospital with which the candidate serves, if in the United States or Canada, must be registered by the American Medical Association and/or approved by the American College of Surgeons.

The candidate must hold membership in local, State or regional, and American hospital associations. Such membership may be personal or through the institutional membership of his or her hospital.

The candidate must present evidence of interest and participation in local, State or regional, and national hospital activities.

The candidate must present evidence of good moral character and ethical conduct.

The candidate must present evidence of having had an adequate academic education as represented by graduation from a college. university, or professional school, or must present evidence of equivalent preparation.

The candidate must submit an application setting forth his or her qualifications and giving the names of five acceptable references, two of whom, at least, shall be either members or fellows of the College.

Initiation fee $25, annual dues $20.

Fellowship

In order to qualify for election as a fellow the candidate must have been a member in good standing for at least 3 years.

At the time of election the candidate must be the chief administrative officer of a hospital of at least 100 bed capacity or the assistant administrative officer of a hospital of at least 300 bed capacity.

In all other respects the qualifications prescribed for members shall apply also to candidates for fellowship.

Hospital administrators of recognized standing and who have had at least 10 years of successful experience as the responsible executive officer of a hospital may be, until January 1, 1940, upon the recommendation of the credentials committee, elected to fellowship directly.

Initiation fee $50, annual dues $25.

NEW NAVAL MEDICAL CENTER

Encouraging progress has been made for the constuction of the new Naval Medical Center in Washington. In April 1938 the President approved the Navy Appropriation bill which carried authorization for the purchase of the land and construction of the buildings for this project. The sum of $450,000 will be available during the fiscal year 1939 for purchase of site and preparation of plans. The ultimate cost is limited to $4,850,000. The Naval Medical Center will provide facilities for the medical school, dental school, and hospital.

Suggestions are solicited for planning and equipment of the new buildings. Medical and dental officers, pharmacists, nurses, and hospital corpsmen are requested to submit their ideas on faulty details of present buildings or equipment, or features which would be desirable in the new institution. Send them to the Officer in Charge of Hospital Planning, Bureau of Medicine and Surgery. This important detail has been assigned to Captain Lucius W. Johnson, Medical Corps, United States Navy, who has recently reported for this duty following detachment as Executive Officer of the U. S. Naval Hospital, San Diego, California.

COMMITTEE TO STUDY SERODIAGNOSTIC TESTS FOR SYPHILIS

Plans are being developed by the American Society of Clinical Pathologists and the U. S. Public Health Service for an assembly of laboratory workers from the entire country to study serodiagnostic tests for syphilis. The proposed meeting, under the auspices of the Committee on Evaluation of Serodiagnostic Tests for Syphilis, with Surgeon General Thomas Parran, chairman, is scheduled for October 21 and 22, 1938, at Hot Springs National Park, Arkansas.

The aims and purposes of the assembly will be to consider means and methods to improve and to make more generally available the serologic tests, which are so important in syphilis control work. The intensive campaign to stop the spread of syphilis now being waged throughout the country makes it imperative that only those serologic tests of proved efficiency be made available to private physicians and health officers. Diagnosis of syphilis must be prompt and accurate. The serologic blood test, becoming positive within two or three weeks after the onset of primary syphilis and remaining positive in the vast majority of untreated patients throughout the entire course of the disease, is the most important evidence of the existence of syphilis. Tentative arrangements call for the presentation of the program in four sections.

The first section will consider the need for adherence to conventional technic in the routine performance of reliable serodiagnostic tests. This subject will be considered in papers by Drs. Harry Eagle,

William A. Hinton, Reuben Kahn, Benjamin Kline, and John H. Kolmer, with special reference to the tests which each of these workers has described.

Need for training of laboratory personnel will be the subject of the second section. The qualifications and training for both laboratory directors and technicians will be presented in separate papers.

The third section will discuss the prosecution of the studies to evaluate the performance of serologic tests within the States. The efficiency of branch State laboratories and of municipal, hospital, and private laboratories cannot be studied on a national basis. The subject is much too large. Should this be made a function of the State or large municipal department of health? Actual experience with such studies in the States of Maryland and New Jersey and in the city of Cleveland will be described.

The fourth section will consider the desirability of licensing or approving for the performance of serodiagnostic tests for syphilis, laboratories within the States by the respective State departments of health. This discussion will be conducted from the standpoint of the private laboratory director by Dr. Frederick H. Lamb of Davenport, Iowa. The health officer's side will be presented by Dr. A. Wadsworth, State Department of Health, Albany, New York.

Committees from each of the four sections will draft recommendations for presentation to the assembly. General discussion will follow the presentation of each set of recommendations.

An additional feature of the meeting will be an actual demonstration of the performance of the Eagle, Hinton, Kahn, Kline, and Kolmer tests by the originators of these procedures.

The work of the Committee on Evaluation of Serodiagnostic Tests for Syphilis is sufficiently well known to require no comment. It is the opinion of this Committee that its studies of the efficiency of the performance of serologic tests have progressed to a point where material gains would be made by a thorough discussion on common ground in which all those interested in the control of syphilis through laboratory methods may participate.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The EDITOR, UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

ATLAS OF HEMATOLOGY, by *Edwin E. Osgood, M. A., M. D., Assistant Professor of Medicine and Head of Experimental Medicine and by Clarice M. Ashworth, Medical Illustrator, both of the University of Oregon.* First edition, 225 pages, illustrated. J. W. Stacey, Inc., San Francisco, 1937.

The price of this Atlas is $10.00 and not $15.00 as reported in the April issue of the Bulletin.

PRACTICAL TROPICAL SANITATION, by *J. Balfour Kirk, M. D., M. B., Ch. B., M. R. C. P., D. P. H., D. T. M., & H. Director.* The Medical and Health Department, Mauritius.

This book is convenient in size and form, and contains much that is condensed from the author's larger work, "Public Health Practice in the Tropics."

The author has succeeded admirably in his purpose of putting into a moderately priced book in the English language material suitable for the use of sanitary inspectors working in the tropics.

The book might further be reduced in price by eliminating the first two chapters, as the subject matter covered in them is easily accessible from other sources.

In discussing the abuse of disinfectants Dr. Kirk makes the following characteristic remarks, "The application of disinfectants is no substitute for cleanliness." "Much money is wasted annually in the disinfection of places which really need only ordinary cleansing."

Illustrations are adequate and well chosen.

ORGANIZATION, STRATEGY, AND TACTICS OF THE ARMY MEDICAL SERVICES IN WAR, by *T. B. Nicholls, M. B., Ch. B., Lt. Col., Royal Army Medical Corps.* William Wood & Co., Baltimore, Md., 1937. Price $4.

A comprehensive selection of medical information has been prepared by the author so as to provide a source of ready reference for the medical officer. Various field medical problems and their solu-

tions are presented. Much of the data are based largely upon actual experiences in the World War, which renders a book of this type of great practical value. The book is divided into four sections.

Part I. General Organization and Administration. This part deals with general organization and administration and gives the reader a working knowledge of staff organization and function. It thoroughly covers the general principles of war as applied to the medical service, such as orders, reports, returns, casualty estimates, and the factors of time, space, and transport.

Part II. The Medical Units, Their Composition, Organization, and Administration. The composition, organization, and equipment of each medical unit is described. The discussion of each unit is taken up systematically under headings such as site, capacity, strength, load tables, organization, duties, etc. In this section hospital ships are classified and their tactical employment is discussed. One of the most useful portions of part two is the chapter entitled "Useful Data," which contains load tables, experience tables, etc.

Part III. Medical Tactics and Strategy. This part is very instructive in that it deals with the "big picture." The duties of a staff medical officer are painstakingly enumerated under the following captions: The Strategical Reconnaissance of the Base; The Embarkation; The Disembarkation; The Strategical Concentration; Approach March; Contact with the Enemy; and The Battle.

Part IV. A Selection of Exercises and Problems to illustrate the above. Part IV consists of several problems and exercises, some of which are solved and others which are left without solution as material for exercise. The examples are complete and include an Appreciation of the Situation, a plan and appendices (Annexes are: Strength of Force; Calculation of Sick; Calculation of Number of Wounded; Table of Medical Units Required; Table of Priority of Embarkation; Table of Extra Stores; and Methods of Evacuation.

The book as a whole is an excellent one and is by far the most comprehensive work on this subject that the reviewer has had the pleasure of studying. It would be more convenient to a foreign reader if a glossary of British medical abbreviations and terms were incorporated. As a matter of comparative interest it is noted that the British "Appreciation of the Situation" parallels the American "Estimate of the Situation" in phraseology and procedure.

THE DIVISION OF PREVENTIVE MEDICINE

Commander C. S. STEPHENSON, Medical Corps, United States Navy, in charge.

THE EFFECT OF THE AGE OF NEOARSPHENAMINE ON REACTION EXPECTANCY

By Commander C. S. STEPHENSON,[1] Medical Corps, United States Navy, Associate Pharmacologist T. F. PROBEY,[2] and Senior Surgeon W. T. HARRISON,[2] United States Public Health Service.

In a recent study by Probey and Harrison[3] the stability of neoarsphenamine is reported to be affected adversely by the age of the material and by incomplete drying of the powder. The percentage of lots showing evidence of deterioration increased as one, or both, of these factors became greater. Although animal toxicity was not investigated, insolubility being the sole criterion of instability, the findings suggested the advisability of ascertaining what effect age of the material might have as a contributing factor in clinical reactions following neoarsphenamine therapy.

Roth[4] reported that changes in the physicochemical character of neoarsphenamine were not accompanied necessarily by an increase in animal toxicity and that an increase in animal toxicity was apparent in material showing no evidence of deterioration. The material was under 3 years old.

Kolmer[5] noted that cloudy or opalescent solutions of neoarsphenamine are invariably more toxic for the lower animals and man than the perfectly clear solutions.

Probey and Harrison's study of the stability of neoarsphenamine included 638 different lots ranging in age from 1 to 7 years. Deterioration was noted in 15 percent of the 1-year-old lots and as the age increased the percentage increased to 66 percent of the 7-year-old material.

Deterioration of neoarsphenamine may be classified as being of two types: one with physicochemical changes which may be accom-

[1] Division of Preventive Medicine, Bureau of Medicine and Surgery.

[2] National Institute of Health.

[3] Probey, T. F., and Harrison, W. T. The Effect of Moisture and Age on Stability of Neoarsphenamine. Reported on p. 429 of this issue.

[4] Roth, G. B. Keeping Qualities of Market Samples of Neoarsphenamine while in Ampule. Pub. Health Rep., 36: 2523 (October 14, 1921).

[5] Kolmer, J. A. Chemotherapy, p. 629. Wm. B. Saunders Co., Philadelphia (1926).

panied by increased animal toxicity, and another in which the toxicity has increased without evidence of physical change. The former type with visible physical evidence of deterioration offers no problem to the clinician, but the latter, which cannot be detected by examination of the powder or the solution, is of importance as it may be reflected in the reaction expectancy. Unfortunately, it is extremely difficult to show slight toxic change by the animal test unless very extensive tests are made using a large number of animals and, moreover, it would be difficult to interpret these findings in terms of human toxicity. The only practical means of determining the actual influence of this type of deterioration is by an extensive clinical study.

An investigation showing the relation of age of the material as a possible factor in reactions following neoarsphenamine therapy can only be accomplished with the cooperation of a service with extensive clinical material and the laboratory charged with the official control of the arsphenamines. Since 1924 the medical officers of the United States Navy [6] have been required to report all arsenical administrations and to report separately, in detail, each case of unfavorable reaction following arsenical therapy. During the 12-year period 1925–36 administration of 1,087,083 doses of neoarsphenamine have been recorded with 854 reactions of all types, the incidence being 1 reaction to every 1,272 injections.[6] The National Institute of Health, charged with the administration of the arsphenamine control, has a record of every lot of the several licensed arsphenamines available for clinical use, including the date that each lot was officially released for distribution. Only this institute has the information necessary to identify the age of every lot of the arsphenamines in clinical use in the United States.

The clinical reports of the United States Navy of all neoarsphenamine therapy for the 5-year period 1933–37, inclusive, were taken for study. These records were investigated for all essential information and then the age of each lot of neoarsphenamine administered was ascertained by the National Institute of Health. The clinical reports were classified according to the year of administration and the age of each lot was estimated by the year of official release, i. e., material released in 1935 and administered during 1937 is recorded as having an average age of 2 years.

Since the material is taken entirely from United States Navy records and represents all neoarsphenamine administered by all of its medical services during a continuous period of five years, it is assumed that all other factors which might influence the reaction ratio

[6] Stephenson, C. S., and Wingo, E. H. Toxic Effects of Arsenical Compounds as Administered in the United States Navy in 1936 with Special Reference to Arsenical Dermatitis. U. S. Naval Med. Bull., 35: 517 (October 1937).

are fairly constant. During this period no essential change has been made in the management of antisyphilitic therapy.

The material covered (table 1) comprises all the neoarsphenamine administered during the 5-year period. The clinical record for each year is detailed separately, showing the age of the material by years with the number of doses administered and the reactions. The totals give the summary for the entire period showing the number of doses and reactions with the reaction expectancy according to the age of the material.

The total number of administrations was 541,381, representing 326 lots of 3 different manufacturers. The reactions recorded were 426, and were classified according to severity as mild, 270; severe, 140; and deaths, 16. The reaction expectancy is 1 to 1,270 doses, which is in agreement with a previous United States Navy report of 1 to every 1,272 doses.[6]

The reaction expectancy increases as the age of the material increases, excepting lots with an average age of 3 years which show a slight decrease. The material with an average age not in excess of 3 years shows a reaction expectancy of 1 to 1,312 doses as compared with the ratio of 1 in 870 doses in material older than 3 years, an increase of approximately 65 percent.

Analysis of 541,381 human doses of neoarsphenamine from all medical services of the United States Navy over a continuous 5-year period shows that the reaction expectancy increases with the age of the material. This clinical experience agrees with the laboratory observation that neoarsphenamine changes with age.

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[6] See footnote on p. 426.

Analysis of 541,381 clinical administrations of neoarsphenamine according to the age of the material

Year of clinical use	Average age, in years, at the time of administration																				
	Current			1 year			2 years			3 years			4 years			5 to 7 years			Total		
	Lots	Doses	Reactions	Lots	Doses	Reactions	Lots	Doses	Reactions	Lots	Doses	Reactions	Lots	Doses	Reactions	Lots	Doses	Reactions	Lots	Doses	Reactions
1937				23	29,768	16	10	9,985	5	22	32,099	17	2	7,177	6	8	2,765	1	65	81,794	45
1936	13	4,514	2	8	11,733	4	22	37,414	26	4	23,440	18	8	13,028	13	7	773	7	62	90,902	70
1935	2	1,242	0	20	22,861	39	6	43,114	27	8	42,410	27	3	4,021	9	3	23	0	42	113,671	102
1934	5	2,279	1	4	21,803	23	11	73,742	79	6	19,130	14	8	727	0	1	118	0	35	117,799	117
1933	3	832	0	10	105,317	68	5	15,890	13	7	9,785	8	5	985	1	2	4,406	2	32	137,215	92
1933–37 (totals)	23	8,867	3	65	191,482	150	54	180,145	150	47	128,864	84	26	25,938	29	21	8,085	10	236	541,381	426
Reactions:																					
Mild			2			84			102			49			25			8			270
Severe			1			62			42			31			3			1			140
Fatal			0			4			6			4			1			1			16
Reaction ratio to doses 1		2,956			1,276			1,200			1,510			894			808			1,270	

Reaction expectancy: Lots current to average age 3 years: 1 to 1,312 doses. Lots average age in excess of 3 years: 1 to 870 doses.

THE EFFECT OF MOISTURE AND AGE ON STABILITY OF NEOARSPHENAMINE [1]

By Associate Pharmacologist T. F. PROBEY,[2] and Senior Surgeon W. T. HARRISON,[2] United States Public Health Service, Washington, D. C.

The instability of the arsphenamines, especially neoarsphenamine, has been recognized since they were first developed. To retard as far as possible deterioration of neoarsphenamine the United States Pharmacopoeia recommends as follows: [3]

> Preserve neoarsphenamine in sealed tubes of colorless glass, from which the air has been excluded either by the production of a vacuum or by displacement with a nonoxidizing gas, in a cool place, preferably not above 10° C.

From time to time, the National Institute of Health has been requested to reexamine certain lots of the arsphenamines ranging in age up to 15 years from date of manufacture. Although arsphenamine is relatively stable, the institute would be reluctant to recommend use of any member of the arsephenamine group, however stable, of such unusual age. These instances illustrate that it is possible for the more unstable arsphenamines of this age to be available for clinical use. This suggests the advisability of restudy of the entire question with reference to the adoption of an expiration date.

Because neoarsphenamine is generally considered the least stable of the group, and because it is the most widely used, it was deemed advisable first to concentrate the investigation on this drug rather than attempt a general survey of all the arsphenamines. The percentage of lots of neoarsphenamine which showed evidence of deterioration by the survey was surprisingly high, indicating that a comprehensive study was necessary to determine the time limitation for neoarsphenamine and to ascertain, if possible, the factors which may influence this stability.

These factors may be numerous, especially those of chemical origin due to its delicate, indefinite structure, but the physical factors, such as storage, age, temperature, dryness of the powder, etc., are to a large extent controllable and reducible to the minimum of effect. Protection against deterioration due to exposure to air, improper storage, and temperatures are accounted for by the provision referred to in the United States Pharmacopoeia and generally followed and recommended by all manufacturers. The effect of age of the product and incomplete drying of the powder were considered of principal importance in this investigation.

Roth,[4] 1921, recorded that neoarsphenamine was unstable and that deterioration is a general phenomenon which may occur in all prod-

[1] Published concurrently in the Public Health Reports.
[2] National Institute of Health.
[3] Neoarsphenamine. U. S. Pharmacopoeia, p. 240.
[4] Roth, G. B. Keeping Qualities of Market Samples of Neoarsphenamine while in Ampule. Pub. Health Rep., 36: 2523 (October 14, 1921).

ucts. His experience with material at the Hygienic Laboratory (now National Institute of Health) was that 25 to 30 percent of material 2 years old from two manufacturers had become insoluble. It was also recorded that similar experiences were noted with products of other countries. Van den Branden and Dumont,[5] 1933, called attention to the influence of time and temperature upon the stability of neoarsphenamine.

Kolmer[6] recorded changes in the powder but was of the opinion that such changes were present in only a few ampules of a lot, found only in 5 to 12 percent of the ampules. He suggested the probability that such deterioration was due to defective handling and ampuling.

The possible influence of "moisture" as a cause of deterioration was noted by Roth[7] in one sample of neoarsphenamine consisting of two different shipments, one drier than the other. The drier sample was satisfactory after some 14 months, whereas the other sample was insoluble.

Kolmer[6] called attention to humidity at the time of ampuling as a possible factor in causing deterioration of neoarsphenamine.

The loss in weight due to drying of the arsphenamines, especially arsphenamine, was recorded as early as 1911 by Garbel.[8] Subsequently, considerable work was reported and the nature of the volatile substances was discussed extensively. The loss in weight after drying neoarsphenamine was recorded by Raiziss and Falkov[9] as varying from 3.63 percent to 4.46 percent (four samples). Myers[10] reported the loss for the other salvarsan substitutes was practically the same as the reported 7.5 percent for salvarsan.

The material tested consisted of samples of neoarsphenamine routinely submitted to the National Institute of Health for official test in compliance with the arsphenamine regulations,[11] during the 8-year period from 1930–37, inclusive, and a few samples of foreign material, purchased or obtained by courtesy directly from the manufacturers. There were 1,004 different lot numbers of neoarsphenamine examined.

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[5] Van den Branden, F., and Dumont, P. Influense Sunultanee du Temps et de la Temperature sur la Conservation des 914 Conserves en Ampule. Ann. Soc. Belge de Med. Trop., 13: 455–471 (December 31, 1933).

[6] Kolmer, J. A. Chemotherapy. p. 629 W. B. Saunders and Co., Philadelphia, 1926.

[7] Roth, G. B. The Deterioration of Neoarsphenamine. J. Am. Med. Assn., 78: 1191 (April 22, 1922). Also see Reference No. 4.

[8] Garbel, G. O. Die Quantitative Zusammensetzung des Salvarsans. Apotheku zeitung, 26: 215 (November 22, 1911).

[9] Raiziss, G. W., and Falkov, M. Chemistry of Neoarsphenamine and its Relation to Toxicity. J. Biol. Chem., 46: 209 (March 1921).

[10] Myers, C. N. Development of the Chemotherapy of Organic Arsenicals and the Related Physical Properties. J. Lab. and Clin. Med., 7: 17 (October 1921).

[11] Regulations for the Control of the Manufacture, Importation, and Sale by Arsphenamine and its Derivatives. Mis. Pub. 22, U. S. Pub. Health Serv.

The products of seven manufacturers holding American license make up the bulk of the material. All lots of several manufacturers were tested and for each of the others, some 20 different lots from each year were picked at random, representing even distribution as to the season of the year of manufacture. The material representing the period from 1930 to 1936, inclusive, 1 to 7 years old, consisted of 638 different lot numbers. The 326 lots of the current (1937) material represented practically all lots received for official test.

All material, except 1937 samples tested at the time of receipt for official test and recorded as current lots, has been stored in a basement room below ground level on the north side of a stone building. This storage is considered as being better than average store room conditions with temperature slightly lower than 20° C.

The foreign material was represented by 40 different lot numbers of neoarsphenamine from 13 manufacturers located in 8 countries. Of the 40 lots, 31 may be considered as current material. The remaining nine lots were old samples from the file of this institute.

The evidence of stability in this investigation is based entirely upon solubility, i. e., the powder must be completely soluble and the solution clear and transparent in a 10 percent solution.[12]

The moisture content is defined as the loss in weight caused by the extraction of volatile substances by drying in vacuo over phosphorous pentoxide for 24 hours, recorded in the percentage which the weight loss bears to the original weight. The identification of the volatile material is of no importance in this study.

The method employed consisted of exposing approximately 0.9 gram of neoarsphenamine in a weighing bottle of 25 millimeters diameter over fresh pentoxide in a vacuum desiccator of 250 millimeters diameter, at less than 5 millimeters pressure, for 24 hours at room temperature. The pentoxide was exposed in a 150-millimeter culture dish and was renewed for each batch of samples. The procedure permitted determinations of not more than 15 samples at one time in a desiccator. This method does not reduce the material to constant weight, as was determined by longer exposure, but in order to keep the test simple and within reasonable time limits the time of exposure to drying was fixed at 24 hours. Adjustments can be made to obtain constant weight but the additional time and necessary weighings offer no practical improvement in the test except to obtain the loss computed on dryness to constant weight which would be slightly higher than figures based on 24 hours of drying.

The moisture content of the 1,004 lots detailed in table 1 varied from less than 0.5 percent to 14.0 percent, only 4 lots were greater

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[12] **Preparation and Administration of Arsphenamine and Neoarsphenamine.** Pub. Health Rep., **37:** 1867 (August 4, 1922).

than 7.0 percent, approximately 75 percent (755 lots) were under 3.0 percent, and 43 percent (426 lots) under 1.0 percent. The distribution of the material according to age, previously described, consisted of 638 lots received during 1930 to 1936, inclusive, detailed in table 2, by age from 1 to 7 years, 326 lots received during current year, and 40 lots of foreign manufacture which, except for a few batches, is of unknown date but believed to be in current clinical use.

The current (1937) lots received from the manufacturers for official test were examined at the time of their receipt. All of the 326 lots examined were satisfactory. The moisture content varied from less than 0.5 to 6.0 percent, only eight lots contained more than 3.5 percent, and approximately 64 percent were under 1.5 percent. Inasmuch as these lots are not classifiable by age or instability they are included only in table 1, giving the total lots tested with moisture distribution. The moisture content of the 40 lots of foreign manufacture indicated considerable variation in the amount of volatile material present. There was insufficient material, however, for satisfactory comparative appraisal. The age of these lots not being definitely known, they are recorded only in table 1.

In table 2 is detailed the record of the 638 different lot numbers of neoarsphenamine from seven different licensed manufacturers received during the 7-year period from 1930 to 1936, inclusive. It will be noted that the stability of neoarsphenamine is affected by age and moisture content, deterioration being directly proportional to these influencing factors. As one or both increases the percentage of instability likewise increases.

The influence of the age of the product, without consideration of the moisture content, is detailed on the bottom line of totals. There it will be seen that the unsatisfactory lots increased from 15 percent (14 of 92 lots) in the 1-year old material to 66 percent (68 of 103 lots) in the material 7 years old. The instability of neoarsphenamine progressively increases as the age increases.

The effect of the moisture content on stability without regard to the age of the drug is shown in the last column—1 to 7 years. The record clearly demonstrates that as the moisture content increases the stability decreases, for example, all of the 12 lots having less than 0.5 percent moisture were stable, but as the moisture increased the percentage of stable lots decreased to zero at the 5.0 percent moisture level.

The deterioration due to age at a definite moisture level or the effect of moisture for a specific period, can be determined by study of table 2. The percentage of instability increases in both directions as the influencing factors increase, except that at the 0.5 percent moisture level all products were satisfactory.

It is indicated that instability of neoarsphenamine is common in products after 2 years with a moisture content in excess of 2.5 percent,

after 3 years with 2.0 percent moisture content, and that after 4 years only an extremely dry product (less than 0.5 percent moisture) may remain stable.

Analysis of the report of the stability of the products from 1 to 3 years old indicates that there is little difference in the deterioration at the 0 to 1.5 percent as compared with the 0 to 2.0 percent moisture level, the former records 98 percent stable as compared with 96 percent of the latter group.

The small number of lots at these two moisture levels in the 3-year-age period available for study does not permit a definite appraisal of comparative stability. It is felt, however, that in the interest of safety the lower moisture content should be recommended as being in conformity with the general observation that instability increases with the moisture content.

The adjustments necessary for the manufacturers to produce a product of low moisture content are apparently not difficult to accomplish. The several licensed manufacturers have been apprised of these findings and have proceeded to accomplish this objective. The samples received during the current year are approximately equally divided into two groups: the early products before the results of the moisture study were known and the latter products during and after adjustment. In the former group, approximately 48 percent were under 1.5 percent moisture content whereas of the latter group 76 percent are in this classification. Recently this percentage has been materially increased and now only the occasional sample is higher than 1.5 percent.

Conclusions

This investigation indicates that the stability of neoarsphenamine is affected by the age of the product and by the moisture retained in the powder and that instability increases directly as one, or both, of these influences are increased. Neoarsphenamine containing not more than 1.5 percent volatile material as determined by the method herein described may be expected to remain stable for 3 years when stored at a temperature slightly less than 20° Centigrade.

TABLE 1.—*Moisture content distribution—1,004 lots of neoarsphenamine*

Moisture content in percentage	Number of lots	Moisture content in percentage	Number of lots
0.0 to 0.5	33	4.5 to 5.0	28
0.5 to 1.0	191	5.0 to 5.5	11
1.0 to 1.5	202	5.5 to 6.0	15
1.5 to 2.0	136	6.0 to 6.5	7
2.0 to 2.5	108	6.5 to 7.0	2
2.5 to 3.0	85	7.0 to 14.0	4
3.0 to 3.5	78		
3.5 to 4.0	57	Total	1,004
4.0 to 4.5	47		

64743—38——8

TABLE 2.—*The effect of age and moisture on the stability of neoarsphenamine*

[Six hundred and thirty-eight different lots from 7 manufacturers holding American license. Stored at better than average room temperature]

Moisture content in percentage	Age, in years, from official release																	
	7		6		5		4		3		2		1		1 to 7			
	Lots		Lots		Lots		Lots		Lots		Lots		Lot		Stable lots		Unstable lots	Total lots
	Stable	Unstable	Stable	Unstable	Stable	Unstable	Stable	Unstable	Stable	Unstable	Stable	Unstable	Stable	Unstable	Number	Percent		
0.0 to 0.5	2	0	3	0	......	......	1	0	2	0	3	0	1	0	12	100	0	12
0.5 to 1.0	9	7	8	4	12	2	5	4	13	0	15	0	13	0	75	82	17	92
1.0 to 1.5	0	10	13	7	9	12	7	5	9	2	16	0	23	0	77	68	36	113
1.5 to 2.0	7	4	4	7	7	5	14	4	10	2	13	0	4	1	59	72	23	82
2.0 to 2.5	6	8	6	6	7	5	2	3	4	2	5	0	14	0	44	65	24	68
2.5 to 3.0	10	4	5	7	3	5	1	8	4	5	0	4	4	4	27	42	37	64
3.0 to 3.5	1	9	3	2	0	5	1	10	3	10	3	1	10	5	21	33	42	63
3.5 to 4.0	0	7	1	2	0	3	1	6	0	9	3	12	3	2	8	16	41	49
4.0 to 4.5	0	8	0	4	0	7	0	2	2	5	1	11	4	1	7	16	38	45
4.5 to 5.0	0	2	0	7	0	2	0	4	0	3	1	4	1	1	2	8	23	25
5.0 to 5.5	0	1	0	1	0	6	0	1	......	......	......	......	......	......	0	0	9	9
5.5 to 6.0	0	3	0	6	......	......	0	1	......	......	......	......	1	0	1	9	10	11
6.0 to 7.0	0	5	......	......	......	......	......	......	......	......	......	......	......	......	0	0	5	5
0.0 to 1.5	11	17	24	11	21	14	13	9	24	2	34	0	37	0	164	76	53	217
Percent	39	61	68	32	60	40	59	41	92	8	100	0	100	0	76	......	24	......
1.5 to 7.0	24	51	19	42	17	38	19	39	23	36	26	32	41	14	169	40	252	421
Percent	32	68	31	69	31	69	33	67	39	61	45	55	75	25	40	......	60	......
Total	35	68	43	53	38	52	32	48	47	38	60	32	78	14	338	52.2	305	638
Percent	34	66	45	55	42	58	40	60	55	45	65	35	85	15	52.2	......	47.8	......

INSECTICIDAL POWDERS, A COMPARATIVE STUDY[1]

By Commander F. S. Johnson, Medical Corps, United States Navy, with the technical assistance of Pharmacist's Mate, first class, A. G. Vallee, United States Navy

Crowded living conditions provide a market without a dull season for an ant and roach killer which will do a thorough job. Immensely important is the fact that there are now available preparations which can be effectively employed against insects without an objectionable or harmful residue remaining to endanger public health.

Sodium Fluoride

Sodium fluoride, as a constituent of powders, has been one of the most widely employed insecticides. The toxic properties of sodium fluoride have not been generally appreciated, and it is probable that many cases of poisoning with this compound have passed unrecognized. The accidental and suicidal ingestion of insect powders, and chronic poisoning from contaminated water supplies, have established the fluorides as constituting a definite public health hazard. The widespread use of sodium fluoride in insect control makes it imperative that all be aware of the poisonous properties of this chemical.

It has become increasingly apparent in Europe, due largely to the researches of Christiani,[2] that the continued ingestion of small quantities of the salts of fluorine produces in animals and in man a clinical state evidenced by cachexia, anemia, fragility of bones, stiffness of the joints, and respiratory paralysis in the fatal cases. From the mining of creolite, which is a fluoride of sodium and aluminum with quartz, workers principally in Scandinavia and Canada are exposed to the hazard of swallowing the dust. Flemming-Møller and Gudjonsson[3] have made a remarkable roentgenographic demonstration of bone changes occurring in these workers. They found the symptoms described as resulting from the ingestion of fluorine salts exactly reflected in the creolite workers. Opacity of the bones and calcification of the ligamentous attachments were in rough proportion to the length of employment in this work. There were silicotic lesions from the inhalation of the quartz contained in the dust of the ore, gastric irritation from swallowing the dust (fluorine intoxication), and anemia attributed to destruction of bone marrow. The

[1] From the laboratories of the United States Naval Medical School, Washington, D. C. A companion article on liquid insecticides by the same authors was published in the July 1937 Bulletin.

[2] Christiani, H.: Detection and Prevention of Flourine Poisoning, Presse med., 35: 578, 1927. Christiani, H., and Chausse, P.: Chronic Poisoning from Small Doses of Sodium Flouride, Compt. Rend. Soc. de Biol., 96: 343, 1927.

[3] Flemming-Møller, P., and Gudjonsson, Sk. V.: Massive Flourosis of Bones and Ligaments, Acta Radiol., 13: 269, 1932.

authors concluded that the osseous changes observed in these cases were due to the fluorine contained in the creolite.

In America, Reynolds, Ross, and Jacob[4] have estimated that 90,000 tons of pure fluorine are added to the soil of this country each year. This is occasioned by the extensive use of phosphate rock in the manufacture of superphosphate fertilizers. Phosphate rock contains about 4 percent of fluorine. Bishop[5] has recently reported pronounced bone changes in a worker who handled this powdered rock. It is also important to note that baking powder may contain perceptible amounts of fluorine, since, as Bishop has pointed out, rock phosphate has been used extensively as a source of phosphates in the manufacture of baking powder.

The first report of dental fluorosis was made about 35 years ago by Eager,[6] a public health officer then stationed at the port of Naples in Italy, who noted a permanent discoloration of the teeth of Italian emigrants from certain communities, and in his report he commented on the possibility of some toxic element in the drinking water acting as the causative agent. A similar affection of the dental enamel was first reported in the United States in 1916 by Black and McKay,[7] who described the condition as "mottled enamel," distinguished pathologically by the absence of cementing substance between the enamel rods. In 1931, Smith, Lantz, and Smith[8] produced the same condition experimentally in rats by feeding them sodium fluoride. Since then this condition has been frequently reported in the United States. Recent studies conducted by the Ohio State Department of Health[9] have revealed that 48 communities in that State have public water supplies containing toxic amounts of fluoride, and that dental fluorosis is endemic in these areas.

A significant experimental study was reported by Brandl and Tappeiner[10] in 1891. They fed sodium fluoride to a dog in increasing doses from 0.1 to 1.0 gram per 24 hours over a period of some weeks and reported that the Haversian canals became completely filled with crystals of calcium fluoride, and that the ligamentous

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[4] Reynolds, P. S., Ross, W. H., and Jacob, L. D.: The Fluorine Content of Phosphate Rock, J. Ass. Agr. Chem., 2: 237, 1928.

[5] Bishop, P. A.: Bone Changes in Chronic Fluorine Intoxication, Am. J. Roent. & Rad. Therap., 35: 577, 1936.

[6] Eager, J. M.: Denti di Chiaie, Pub. Health Rep., vol. 16, No. 44, November 1901.

[7] Black, G. V., and McKay, F. S.: Mottled Teeth—An Endemic Developmental Imperfection of the Teeth, Heretofore Unknown in the Literature of Dentistry, Dental Cosmos, February 1916, LVIII.

[8] Smith, H. V., Lantz, E. M., and Smith, M. C.: Cause of Mottled Enamel, Defect of Teeth., Univ. of Arizona Agr. Exp. Sta. Tech Bull. No. 32, 1931.

[9] Van Horn, A. L.: Chronic Endemic Dental Fluorosis in Ohio, Ohio State Med. J. 32: 1207, 1936.

[10] Brandl, J., and Tappeiner, H.: Ueber die Ablagerung der Fluorverbindungen im Organismus nach Futtering mit Fluornatrium, Ztschr. f. Biol., 10: 518, 1891–1892.

attachments to the bones were calcified. Stanton and Kahn [11] have more recently reported the presence of calcium fluoride crystals in the bones of animals after fluoride poisoning. These authors also describe the sodium fluoride poisoning of a baby, aged 19 months, who had swallowed some of "Peterman's Roach Food," which contained from 40 to 50 percent of sodium fluoride.

The whole subject of sodium-fluoride poisoning is well discussed by Sharkey and Simpson [12] of Dayton, Ohio, by Carr [13] of the San Francisco coroner's office, and by Geiger [14] of the department of public health, city and county of San Francisco, but it is difficult to obtain a comprehensive listing of all cases of sodium fluoride poisoning, because most of the States in tabulating their statistics merely place the suicides in one column and the deaths from accidental poisoning in another without separation as to the kind of poisoning responsible for the death; there is no separate number for specific types of poisoning in the International Classification of Causes of Death. In most public health departments no distinction is therefore made as to the type of poison used, all deaths from ingested poison being assigned to International List No. 163. The records of the State Board of Health of Kansas show, however, that there were three deaths from sodium fluoride reported during the year 1936, all of which were due to sodium fluoride having been taken as a laxative by mistake. In the 5-year period 1931–35 in New York State, exclusive of New York City, there were four deaths from accidental poisoning by sodium fluoride distributed as follows: Two in 1931, one in 1932, and one in 1935. The reports of the chief medical examiner of the city of New York contain records of three accidental deaths from sodium fluoride poisoning in 1918–20, two accidental deaths in 1925, one accidental and one suicidal death in 1926, one accidental death in 1927, three in 1928, one in 1929, six in 1930, eight accidental and two suicidal deaths in 1931, three accidental deaths in 1932, three accidental and five suicidal deaths in 1933, one suicidal death in 1934, and five suicidal deaths in 1935. In Rhode Island the only information available on sodium fluoride is the death certificate of one patient in 1936 who took by mistake what he thought was bicarbonate of soda. Carr's article, referred to above, reports five new cases and alludes to several others. The article by Sharkey and Simpson reports eight new cases and makes reference to many others. Geiger's article reports so many new cases,

[11] Stanton, J. N., and Kahn, M.: Sodium Fluoride Poisoning, J. A. M. A. 64: 1985, 1915.

[12] Sharkey, T. P., and Simpson, W. M.: Accidental Sodium Fluoride Poisoning, J. A. M. A. 100, 97: 1933.

[13] Carr, J. L.: Acute Fluorine Poisoning, Calif. & West. Med., 44, 83: 1936.

[14] Geiger, J. C.: Poisoning Due to the Ingestion of a Mixture of Sodium Bicarbonate-Sodium Fluoride., Calif. & West. Med., 44: 81, 1936.

which cause him to interrogate, "Why do such poisonings not occur with greater frequency?" He implies that many cases probably go unrecognized as "food poisoning," which in reality may be due to the ingestion of small quantities of fluoride or other poisonous insecticide on foodstuffs.

That sodium fluoride is extremely poisonous is well shown by McNally,[15] who relates that incidence of one who mistook sodium fluoride for a laxative powder and died in 45 minutes. Bizot [16] reported a fatal case in a man who had taken a teaspoonful of sodium fluoride, and there are several records of entire families having been poisoned by eating pastry containing sodium fluoride. But despite these experiences sodium fluoride continues to be widely used in this country as an insecticide, and it is still widely dispensed without any indication that it is a poisonous substance.

The following quotation is from a case report by Allen: [17]

> An accidental death occurred in one hospital when roach powder, a mixture of sodium fluoride and sodium silicofluoride, was mistaken for powdered sugar and used in making hard sauce to go with the noontime dessert. The patient who was mixing the sauce, tasted it on several occasions, and then complained of weakness and nausea. He vomited copiously and lapsed into a state of mild shock, which responded well to treatment, though generalized weakness and muscular cramps continued. Some 5 hours later he complained of dyspnea; and expired almost immediately. Autopsy showed subpleural and epicardial hemorrhages, as well as extravasations of blood into the lung tissue and intense hyperemia of the kidneys. The blood was liquid throughout and when examined for calcium by Mr. E. H. Stotz, department of biochemistry, Harvard Medical School, it contained only 5.8 milligrams per 100 cubic centimeters, instead of the normal 10 milligrams per 100 cubic centimeters—the tetany level is approximately 7 milligrams per 100 cubic centimeters. Dr. William F. Boos, toxicologist, found fluorides present in all the organs, as well as in the heart's blood. In this case death was presumably due to an artificial tetany brought about by the fluoride combining with the blood calcium to form a calcium fluoride which is of extremely low solubility. Since this fatality, all the roach powder used in the Massachusetts State Hospitals for Mental Disease is colored so that a similar mistake will not occur.

The symptoms of acute fluoride poisoning seem to be best explained on the basis of the ionization of the compound. The extreme gastrointestinal irritation is undoubtedly enhanced by the presence of hydrofluoric acid formed by the interaction between the ingested sodium fluoride and the hydrochloric acid in the gastric juice. The tetany and convulsive seizures so often seen in these cases are best explained, as Cobert has so well pointed out in his "Lehrbuch der Intoxikationen," and as Allen's report has so clearly shown, by a

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15 McNally, W. D.: Four Deaths Caused by Sodium Fluoride, J. A. M. A., 81: 811, 1923.

16 Bizot, A. R.: Sodium Fluoride Poisoning, Kentucky M. J., 2: 156, 1924.

17 Allen, A. M.: A Review of the Variety of Poisons Which Have Caused Death in the Massachusetts State Hospitals for Mental Disease, New Eng. J. Med., 213: 1013, 1935.

lowering of the blood calcium due to the reaction between the calcium and fluorine ions to form calcium fluoride, which is deposited and stored in the osseous structures. The terminal petechial hemorrhages described by Carr are probably favored by the anticoagulant action of sodium fluoride. Treatment is therefore best accomplished by copious gastric lavage with lime water, and by the intravenous injection of calcium chloride or intramuscular injection of calcium gluconate. The complete removal of fluorine as an insecticide would seem to be the most effective remedy.

Sodium fluoride is at best a very slow acting insecticide. It is apparently much less toxic to insects than it is to humans. At the Naval Medical School cockroaches have been exposed to large quantities of sodium fluoride for a period of 24 hours in glass containers. While so placed in these containers with sodium fluoride roaches remained alive and active for at least 12 hours. They were dead at the end of 24 hours. It is therefore probable that crawling insects may readily contaminate food with sodium fluoride, which may subsequently be unsuspectingly consumed. As expressed in a previous report, the menace to public health of residues of fluorine and other inorganic materials on fruits and vegetables demands that insecticides of the future be organic materials, which are more toxic to insects and less toxic to mammals than are inorganic materials.

Derris and Cube

Derris root, of which there are about 40 species, is grown chiefly in the East Indies. *Derris ellyptica* yields the highest content of rotenone ($C_{23}H_{22}O_6$), which is generally regarded as the active principle in derris, although recent studies [18] indicate that in derris there are many other active principles. An extensive amount of work is being carried out to identify these principles and to determine their potency. Recently in Peru, *Loncho-carpus nicou* (cube root) has been found to have a high rotenone content, and the importation of cube is rapidly increasing. Rotenone has also been found in *Cracca virginiana* (devil's shoestring), which is grown in America, but the rotenone content is low.

Purified rotenone is in the form of colorless and odorless crystals. The real hindrance to the development and use of rotenone has been the very rapid rate of its deterioration. Until the last 4 or 5 years it was not considered to be a practical product because its killing properties were lost so quickly with exposure to light and air. Rotenone protected in the cells of powdered derris or cube root is,

[18] Ambrose, A. M., and Haag, H. B.: Toxicological Study of Derris, Indust. & Eng. Chem., 28: 815, 1936.

however, much less prone to deterioration than pure rotenone. To assure a uniform rotenone content, the powdered derris or cube root is blended after milling and it is then assayed to contain between 4 and 5 percent rotenone, as determined by either the Jones [19] or Rogers-Calamari [20] method. Most manufacturers further stabilize the rotenone in the derris and cube by physical and chemical means, and thus most effectively prolong its period of activity.

Like the pyrethrins, rotenone is chiefly toxic to insects and cold-blooded animals. It is extremely poisonous to fish and reptiles. It is interesting to note that derris root has been used for centuries by the natives in the East Indian Archipelago and the Antipodes as a means of catching fish. They make a milky wash of the root, drop this solution into the fishing area, and then gather the dead and stunned fish into their boats. It is said that the Chinese farmers in the Malay States use a decoction of derris on their crops. American farmers are now adopting derris powder to replace poisonous inorganic chemicals. With the increasing number of deaths due to insecticide residue poisoning, it is very probable that within the next few years the use of poisonous inorganic chemicals for insecticidal purposes will be completely prohibited.

Powdered derris root is used extensively in flea and lice powders for domestic animals. For these purposes the derris powder is usually diluted with talc so as to give a mixture of about 1 percent rotenone content. Sometimes 10 to 20 percent pyrethrum powder (assaying 0.9 percent pyrethrins) is added to obtain further insecticidal action. These flea and lice powders are considered to be harmless to dogs, cats, poultry, and cattle.

Although rotenone, like the pyrethrins, is relatively innocuous to mammals, direct inhalation of powdered derris, such as is likely to occur during milling, may be toxic. There may thus be a possible health hazard to those engaged in milling and grinding derris without the use of suitable protective measures. Recently Mathews and Lightbody [21] of the United States Department of Agriculture have shown that rotenone dissolved in oil does become really toxic to mammals.

Haag [22] of the department of pharmacology, Medical College of Virginia, has studied the effect of prolonged feeding of rotenone and derris powder. He gave rabbits 60 milligrams of derris per kilogram daily without evidence of toxicity. Haag concludes from experi-

[19] Jones, H. A.: Assay of Plant Material for Its Rotenone Content. Ind. Eng. Chem. Anal. Ed. 5: 23, 1933.

[20] Rogers, H. D., and Calamari, J. A.: Rotenone Determine by Colorimetric Methods. Ind. Eng. Chem. Anal. Ed., 8: 135, 1935.

[21] Mathews, J. A., and Lightbody, H. D.: Toxicity of Derris and Cube, Ind. Eng. Chem., 28: 812, 1936.

[22] Haag, H. B.: Toxicity of Rotenone. Soap. January 1937.

ments on guinea pigs, rabbits, dogs, cats, pigeons, and white rats that there is no danger from the ingestion of rotenone. He himself swallowed about 2.5 grains of rotenone without experiencing symptoms.

Derris is essentially a stomach poison for insects. Its activity as an insecticide is comparable to that of sodium fluoride. It is therefore slow acting, but it is nevertheless a sure killer. Tests at the Naval Medical School have shown that when cockroaches were exposed to either sodium fluoride or derris about 24 hours were required for lethal effect; but the lethal effect was certain in either instance. Derris is therefore slower in action than pyrethrum, but it is undoubtedly effective in ultimate kill of insect pests.

Pyrethrum

A wide demand has developed for pyrethrum (which is not poisonous to man or animals) for insect control. The American consumption of pyrethrum varies from 10 to 15 million pounds per year and is steadily increasing. At present Japan supplies about 80 percent of the world consumption, but Kenya is now making a fair bid for the market. The Kenya flowers contain a higher pyrethrins content than do the flowers grown in any other area.

The insecticidal principles in pyrethrum are known as pyrethrins I and II. These pyrethrins are the esters of the monovalent and divalent chrysanthemum acids. Pyrethrum flowers of acceptable grade should contain not less than 0.9 percent pyrethrins, as determined by either the Gnadinger-Corl [23] or the Seil [24] method. Just as in the case of rotenone, the pyrethrins lose strength rapidly when exposed to light and air. It is estimated that in the first month after milling, pyrethrum powder loses as much as 15 percent of its original pyrethrins content. One of the triumphs of practical scientific research is the stabilization of pyrethrins in powdered pyrethrum. Stabilized pyrethrum powder is now commercially available in concentrated form, which assays from 1.9 to 2.0 percent pyrethrins.

An insect, contrary to the higher forms of animal life, breathes throughout its body. There are numerous spiracles of its breathing system located all along its integument. It was formerly thought that the insecticidal effect of pyrethrum was due to the insect inhaling the dust or spray through the spiracles, but in 1933 Wilcoxson and Hartzell [25] showed that pyrethrum kills primarily by contact

[23] Gnadinger, C. B., and Corl, C. S.: Studies on Pyrethrum Flowers; Quantitative Determination of the Active Principles, J. Amer. Chem. Soc., 51: 3054, 1929.

[24] Seil, H. A.: Estimation of Pyrethrins, Soap, 10, May 1934.

[25] Wilcoxson, F., and Hartzell, A.: Some factors Affecting the Efficiency of Contact Insecticides. III. Further Chemical and Toxicological Studies of Pyrethrum, Contrib. Boyce Thompson Inst., vol. 5, No. 1, p. 115, 1933.

with the integument, independently of the respiratory system, the effect being due to paralysis and destruction of nerve ganglia.

When concentrated and stabilized pyrethrum powder is diluted with finely powdered sulphur, an excellent dust for a wide range of effectiveness is produced. Experiments with sulphur and pyrethrum by DeLong [26] have disclosed that sulphur itself when applied to the leaves of a plant will bring about the death of sucking insects. He found that finely ground sulphur (300 mesh) was easy to apply and gave the best results, but he found that a combination of sulphur and pyrethrum gave greatest protection, because the pyrethrum brought about immediate kill of insects present at the time of application, while the sulphur through residual effects, killed insects hatching or appearing later. He used a combination of sulphur and pyrethrum (assaying 0.9 percent pyrethrins) in a ratio of 90 to 10.

Method of Procedure

In the tests conducted at the Naval Medical School cockroaches were dusted with sodium fluoride, sulphur, powdered derris, pyrethrum powder, and with combinations of derris and pyrethrum. One hundred cockroaches were used for these tests. The results are given in table I, in which the indicated percentages for rotenone and the pyrethrins were determined from the percentage content of these active principles in the percentage proportions of powdered derris or pyrethrum powder employed in combination with alkaline-free sulphur (300 mesh) or nonalkaline clay (300 mesh). For example, a mixture of 15 percent derris powder (assaying 5 percent rotenone) and 85 percent sulphur or clay was taken as representative of 0.75 percent rotenone, and a mixture of 15 percent pyrethrum powder (assaying 2 percent pyrethrins) and 85 percent sulphur or clay was considered as representative of 0.3 percent pyrethrins.

TABLE I

	Paralysis	Kill
(1) 0.75 percent rotenone	None	50 percent in 24 hours.
(2) 1.00 percent rotenone	None	75 percent in 24 hours.
(3) 0.23 percent pyrethrins	10 minutes	100 percent in 45 minutes.
(4) 0.30 percent pyrethrins plus 0.75 percent rotenone	7 minutes	100 percent in 30 minutes.
(5) 0.40 percent pyrethrins plus 0.75 percent rotenone	6 minutes	100 percent in 25 minutes.
(6) 0.40 percent pyrethrins plus 1.00 percent rotenone	6 minutes	100 percent in 20 minutes.
(7) 0.50 percent pyrethrins plus 1.00 percent rotenone	6 minutes	100 percent in 20 minutes.
(8) 325 mesh sulphur	None	None.

This table shows time of onset of paralysis and death. Insects were removed to wire cages away from insecticide upon appearance of symptoms. Insects

[26] DeLong, D. M.: Experiments with Sulphur and Pyrethrum, Crop Protection Institute, No. 44, March 1934.

exposed to rotenone in the absence of pyrethrum were removed to cages 5 minutes after beginning of exposure.

TABLE II

	Paralysis	Kill
(1) 15 percent derris	None	50 percent in 24 hours.
(2) 20 percent derris	None	75 percent in 24 hours.
(3) 25 percent pyrethrum	10 minutes	100 percent in 45 minutes.
(4) 15 percent pyrethrum plus 15 percent derris	7 minutes	100 percent in 30 minutes.
(5) 20 percent pyrethrum plus 15 percent derris	6 minutes	100 percent in 25 minutes.
(6) 20 percent pyrethrum plus 20 percent derris	6 minutes	100 percent in 20 minutes.
(7) 25 percent pyrethrum plus 20 percent derris	6 minutes	100 percent in 20 minutes.

This table shows onset of paralysis and death from the combinations of pyrethrum powder and powdered derris in alkaline-free sulphur or nonalkaline clay required to obtain the percentages of rotenone and pyrethrins listed in sequence of table I. The derris assayed 5 percent rotenone and the pyrethrum assayed 2 percent pyrethrins, except No. 3 which assayed 0.9 percent pyrethrins. The percentage proportions of derris and pyrethrum powder in alkaline-free sulphur or nonalkaline clay employed to obtain the percentages of active principles enumerated in the sequence of table I. The 25 percent pyrethrum 75 percent sulphur or clay, No. 3 in table II, was a pyrethrum powder obtained from high-grade flowers assaying 0.9 percent pyrethrins. It is therefore evident that 25 percent of this pyrethrum powder (assaying 0.9 percent pyrethrins) yielded only 0.23 percent pyrethrins in the resultant mixture. The pyrethrum used in all the other mixtures was concentrated and contained 2.0 percent pyrethrins. Hence the 15 percent pyrethrum mixture, No. 4 in table II, yielded 0.3 percent pyrethrins; the 20 percent pyrethrum mixtures, No. 5 and No. 6 in table II, yielded 0.4 percent pyrethrins, and the 25 percent pyrethrum mixture, No. 7 in table II, yielded 0.5 percent pyrethrins. The derris powder contained 5 percent rotenone, and it is therefore evident that the 15 percent and 20 percent mixtures of derris contained respectively 0.75 and 1.0 percent rotenone.

DISCUSSION OF RESULTS

It is apparent from a perusal of tables I and II that the optimum pyrethrins content for insecticidal purposes corresponded to 0.4 percent pyrethrins. This finding is in accord with the results obtained by Williams[27] and is consistent with the report of a comparative study of liquid insecticides recently undertaken at the Naval Medical School. To obtain this optimum percentage of pyrethrins in the experimental mixtures, No. 5 and No. 6 in table II, required that the pyrethrum powder be concentrated and contain 2 percent pyrethrins. It was also stabilized in order to avoid the inevitable deterioration of pyrethrins which so rapidly occurs when ordinary pyrethrum powder is exposed to light and air.

Although the 1 percent rotenone gave only a 75 percent kill, the tests with rotenone were conducted under fairly rigid conditions, and the 25 percent difference in kill between the 0.75 percent rotenone and

[27] Williams, C. L., and Dreessen, W. C.: The Destruction of Mosquitoes in Airplanes, Pub. Health Rep., 50: 663, 1935. Williams, C. L., and Dreessen, W. C.: A Nonflammable Pyrethrum Spray for Use in Airplanes, Pub. Health Rep., 50: 1401, 1935.

1 percent rotenone is regarded as highly significant. Rotenone is essentially slow acting. It is a stomach poison, but it seems to appeal to the appetite of the cockroach. These insects ate it readily. Therefore, the roaches were allowed to remain in contact with the powder only 5 minutes, and at the expiration of this time they were transferred to wire cages for subsequent observation.

The working percentage of rotenone is of course dependent on the rotenone content in powdered derris or cube, and hence on the percentage proportion of such powders used in final mixtures. Stabilized derris and cube powders are protected physically against exposure to light and chemically against oxidation, but they should nevertheless be packed in light-proof containers. Since the stabilizing agent required is used in the ratio of 15 percent, to produce a powder having a 5 percent rotenone content is more difficult. Most stabilized derris and cube powders are therefore assayed to contain 4 percent rotenone rather than 5 percent. In these reported tests, since the powdered derris contained 5 percent rotenone, 20 percent of the powder represented 1 percent rotenone in the final mixture. With a powder containing 4 percent rotenone, 25 percent of the powder would be required in the final mixture for a yield of 1 percent rotenone. Similarly 33 percent of a 3 percent stabilized powder would be required for a 1 percent rotenone content.

Dusting cockroaches with sulphur alone was without lethal effect. However, in less than 2 minutes, following the application of either combined sulphur and pyrethrum or pyrethrum alone, roaches displayed a most pronounced degree of hypermotility, followed in a few minutes by complete paralysis. When nonalkaline clay (300 mesh) was used in place of sulphur the results were the same.

It is essential that the carrier of pyrethrum powder be nonalkaline. Lime, for instance, completely destroys pyrethrins. Lime is also deleterious for derris powder, but either alkaline-free sulphur or nonalkaline clay lends itself admirably to this purpose. For thorough mixing of ingredients, the particle size of the sulphur or nonalkaline clay should pass a 300-mesh screen and be so processed that it will flow readily without lumping.

Conclusions

1. The fluorides have been established as constituting a definite public health hazard.

2. The widespread use of sodium fluoride as an insecticide is dangerous. If it must be used, it should be colored. Nile blue is suggested.

3. A mixture of 0.4 percent pyrethrins and 1 percent rotenone with alkaline-free sulphur or nonalkaline clay is a safe insecticide and is more active than sodium fluoride.

4. Stabilized and concentrated pyrethrum powder (assaying 1.90 to 2 percent pyrethrins) offers a ready source of pyrethrins.

5. Stabilized derris or cube powder (assaying 3 to 5 percent rotenone) used in the percentage proportion required to yield 1 percent rotenone, adds to the ultimate insecticidal properties of a powder.

6. Either specially processed alkaline-free sulphur (300 mesh) or nonalkaline clay (300 mesh) is an excellent and economical vehicle for the carriage of pyrethrins (pyrethrum powder) and rotenone (powdered derris or cube). Clay is cheaper than sulphur.

A PRESUMPTIVE TEST FOR THE POTENCY OF COWPOX VIRUS

By Lt. Comdr. J. B. Moloney, Medical Corps, United States Navy

Many conditions arise in which it is desirable to test the potency of cowpox virus. The fact that it is so perishable at ordinary temperatures frequently means that some delay in transmission through the mails, or some time lapsed over the marked expiration date may render the virus sterile and worthless. The following test has been tried and verified many times and has been found to be practicable and reliable. The technique follows:

Two capillary tubes of the virus to be tested are used. One tube is inactivated in a water bath at 140° F. for 1 hour. The other tube is used unchanged. The test consists in observing the difference in reaction in a known immune person between a questionably potent virus and a known killed virus.

The skin of the left arm in that region overlying the insertion of the deltoid is shaved and scoured with ether to remove the surface oils and is allowed to dry thoroughly. Then 1 drop of the inactivated virus and 1 drop of the un-inactivated virus is placed on the shaven and cleaned area. Identical scarifications are made through each of the drops with a sterile needle, separately, care being taken that no trace of the virus is carried over from 1 drop to the other. In order to obviate this possibility 2 needles should be used, or if 1 needle is used it should be flamed between scarifications.

At the end of 48 hours the test is read, although it is frequently possible to make a reading at the end of 24 hours. If there is no difference between the skin reactions, the test is negative. That is, the virus which was to have been tested is dead, therefore useless as far as immunizing against cowpox or smallpox is concerned. If the un-inactivated virus shows the typical reaction of immunity, and the inactivated virus does not, then the test is positive, that is the virus is living and potent, and will inoculate the disease cowpox in a nonimmune person. The inactivated virus serves as a control to eliminate allergic reactions, due solely to the serum.

STATISTICS

HEALTH OF THE NAVY

The following tables are summaries of morbidity rates per 1,000 for the fourth quarter of 1937 in comparison with rates for the corresponding quarter of the preceding 5 years:

Year	All diseases	Injuries	Poisonings	All causes	Communicable diseases		Venereal diseases
					A	B	
ENTIRE NAVY							
1932	502	54	0.15	556	(1)	(1)	129
1933	402	68	.57	471	9	109	89
1934	554	62	5.43	622	26	171	114
1935	409	61	.45	470	8	126	73
1936	474	74	1.62	550	15	118	96
1937	472	36	2.83	511	11	118	93
FORCES ASHORE							
1932	629	63	0.31	692	(1)	(1)	95
1933	523	85	.46	608	9	158	66
1934	610	77	.41	687	35	192	68
1935	427	63	.74	491	9	151	39
1936	459	97	1.14	557	13	121	46
1937	535	42	6.60	583	11	169	55
FORCES AFLOAT							
1932	432	48	0.06	481	(1)	(1)	147
1933	344	60	.62	405	9	86	100
1934	525	53	8.12	586	21	160	139
1935	398	59	.28	457	8	111	93
1936	483	61	1.90	546	15	115	125
1937	435	33	.62	469	10	89	116

[1] Not available.

Common infectious diseases of the respiratory type.—During the quarter, 1,399 cases of the common infections of the respiratory type were reported from shore stations in the United States, 260 from shore stations outside the continental limits of the United States, and 1,493 cases from the forces afloat. Catarrhal fever was responsible for 2,221 of the 3,152 total admissions.

Ships and shore stations recording the greatest number of admissions are shown in the following tabulation:

Ship or station	October	November	December	Total
Naval Training Station, Newport, R. I.	76	111	125	312
Regimental Hospital, Shanghai, China	45	46	139	230
Naval Training Station, Norfolk, Va.	31	39	122	192
Naval Training Station, Great Lakes, Ill.	26	98	55	179
Naval Training Station, San Diego, Calif.	48	46	48	142
U. S. S. *Lexington*	32	22	34	88
Naval Air Station, Pensacola, Fla.	34	31	21	86
Marine Barracks, Quantico, Va.	24	13	27	64
U. S. Naval Academy (midshipmen)	32	9	22	63
U. S. S. *Tennessee*	8	17	24	49
U. S. S. *Colorado*	14	24	10	48

The Naval Air Station, Pensacola, Fla., reported a fatal case of tonsillitis, acute. An aviation machinist's mate, third class, 29 years of age was admitted to the sick list on October 7, 1937, and died on November 5, 1937. The contributory cause of death was recorded as septicemia.

Seven cases of chickenpox were reported for the quarter as follows: In November one case from the U. S. S. *Houston;* and in December one each from the Naval Proving Ground, Dahlgren, Va., U. S. S. *Argonne*, U. S. S. *Mississippi*, U. S. S. *New York*, U. S. S. *Northampton*, and the U. S. S. *Wright.*

One case of scarlet fever was reported by the Naval Training Station, Newport, R. I., in December; one case of whooping cough by the Naval Proving Ground, Dahlgren, Va., in October; and one case of poliomyelitis, anterior, acute, by the U. S. S. *Whipple* in October.

A fatal case of diphtheria was reported by the Brigade Hospital, Second Marine Brigade, Shanghai, China. An officer of the Medical Corps was admitted to hospital on November 6, 1937, for the treatment of acute pharyngitis. A culture taken immediaely was positive for diphtheria. The patient died suddenly on November 15, 1937, the contributory cause of death being dilatation, cardiac, acute.

A case of encephalitis, hemorrhagica, was admitted to the sick list at the Navy Yard, Boston, Mass. The patient was transferred to hospital with symptoms of multiple neuritis, both lower extremities, and acute confusional mental state with defective memory and partial disorientation. Herpes zoster developed and mental confusion and clouding of consciousness increased. A terminal broncho-pneumonia developed and death occurred on November 16, 1937. Diagnosis was confirmed by autopsy.

Typhoid fever and partyphoid fever.—There were seven cases of typhoid fever and two admissions for paratyphoid fever reported during October, November, and December 1937, as follows:

TYPHOID FEVER

Rate	Age (years)	Place of original admission	Date of admission	Severity of case	Date of completion of prophylaxis	Disposition
N. Seaman, first class.	26	Navy Yard, Cavite, P. I.	Oct. 25, 1937	Severe	May 7, 1931; Aug. 16, 1935	Died, Nov. 12, 1937.[1]
Private	21	Marine Detachment, American Embassy, Peiping, China.	Oct. 28, 1937	Moderately severe.	Dec. 4, 1936	Duty, Nov. 26, 1937.
Chief Pharmacist.	39	Naval Hospital, Guam.	Oct. 28, 1937	Not available	Not available	Duty, Nov. 22, 1937.
Corporal	25	Marine Detachment, American Embassy, Peiping, China.	Nov. 4, 1937	Moderately severe (prolonged).	Oct. 12, 1934	Duty, Jan. 11, 1938.
Private	22	do	Nov. 17, 1937	Mild	Dec. 11, 1936	Duty, Jan. 3, 1938.
Private	23	do	Nov. 24, 1937	do	Oct. 2, 1936	Duty, Jan. 17, 1938.
Chief Pharmacist's mate.	35	Naval Hospital, Guam.	Dec. 20, 1937	Not available	Not available	Duty, Dec. 30, 1937.

PARATYPHOID FEVER "A"

Rate	Age (years)	Place of original admission	Date of admission	Severity of case	Date of completion of prophylaxis	Disposition
Private	21	Marine Detachment, American Embassy, Peiping, China.	Nov. 13, 1937	Moderately severe.	Dec. 11, 1936	Duty, Dec. 19, 1937.
Private	24	do	Nov. 16, 1937	Mild	Sept. 14, 1934	Duty, Dec. 30, 1937.

[1] Contributory cause of death "Hemorrhage, intestinal."

Gastroenteritis, acute, Naval Academy, Annapolis, Md.—During the first week of December an outbreak of gastroenteritis, totaling 119 cases, occurred among the midshipmen. Ninety of the cases reported on the first day. The majority of the cases were mild and required hospitalization from 1 to 3 days.

Laboratory examinations showed this outbreak to have been caused by the Gartner bacillus (*S. enteritidis*) which was recovered from samples of the fresh ham used for luncheon December 1. It is believed that the fresh ham in question was infected with this bacillus prior to the receipt at the Naval Academy. The absence of this bacillus from stool cultures of patients indicates that the outbreak was perhaps the result of toxemia rather than a bacteriological infestation of the gastrointestinal tract.

The symptoms in general were nausea; vomiting; diarrhea; general weakness, amounting to prostration in some cases; abdominal cramps and distention; some cases of severe muscle cramps of abdomen and calves of legs, with pain in the back. Temperature was normal in about 10 percent and subnormal in about 90 percent of cases.

Cerebrospinal fever and meningitis, cerebrospinal, acute.—There were two cases of cerebrospinal fever and three cases of meningitis,

cerebrospinal, acute, reported during the fourth quarter of 1937 as follows:

CEREBROSPINAL FEVER

Rate	Age (years)	Place of original admission	Date of admission	Length of service		Disposition
				Yrs.	*mos.*	
Fireman, third class.	19	U. S. S. *California*	Oct. 7, 1937	1	1	Duty, Oct. 29, 1937.
Seaman, second class.	19	U. S. S. *Arctic*	Oct. 29, 1937	0	10	Died, Nov. 7, 1937.

MENINGITIS, CEREBROSPINAL, ACUTE

Rate	Age (years)	Place of original admission	Date of admission	Length of service		Disposition
Shipfitter, third class.	25	Naval Hospital, San Diego, Calif. (prolonged treatment of gonococcus infection).	Oct. 28, 1937	4	0	On sick list at end of year.
Mess attendant, first class.	29	Naval Training Station, Great Lakes, Ill.	Nov. 1, 1937	9	10	Died, Nov. 17, 1937.[1]
Mess attendant, first class.	29	U. S. S. *Vincennes*	Nov. 4, 1937	8	1	Died, Nov. 17, 1937.

[1] Contributory cause of death, "Pneumonia, broncho."

Food poisoning.—An outbreak of food poisoning occurred on board the U. S. S. *Philadelphia* on September 29, 1937. A total of 108 men were treated, 6 of whom were admitted to the sick list and kept in bed for 3 days. Symptoms were griping pain in the lower abdomen followed by frequent loose, watery stools, weakness, nausea, headache, and in the more severe cases, vomiting. Symptoms subsided after the second day.

The food served at the morning meal included fried fresh meat hash (meat ground the night before), fresh milk, oatmeal, baked beans with bacon, tomato catsup, hot corn bread and bread and butter. The men affected were in all the general messes and of the total number questioned only one denied having eaten hash. None of the men affected purchased anything at the ship's service store on that date.

From the nature of the symptoms, the messing distribution of the men affected, and the time elapsing before onset of symptoms, it is believed that the causative agent was the hash served at breakfast and that a toxin apparently developed in the meat from the time of preparation to the time of serving.

INJURIES AND POISONINGS

Admissions for Fourth Quarter Ending December 31, 1937

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the fourth

quarter, 1937, is based upon all Form F cards covering admission in those months which have reached the Bureau:

	Admissions, October, November, and December, 1937	Admission rate per 100,000, per annum	Admission rate per 100,000, year 1937
INJURIES			
Connected with work or drill	482	1,451	2,513
Occurring within command but not associated with work	380	1,144	1,924
Incurred on leave or liberty or while absent without leave	349	1,050	1,760
All injuries	1,211	3,645	6,197
POISONINGS			
Industrial poisoning	3	9	7
Occurring within command but not connected with work	90	271	211
Associated with leave, liberty, or absence without leave	1	3	18
Poisonings, all forms	94	383	236
Total injuries and poisonings	1,305	3,928	6,434

Percentage relationship

	Occurring within command				Occurring outside command—leave, liberty, or A.W.O.L.	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty			
	October, November, and December 1937	Year 1936	October, November, and December 1937	Year 1936	October, November, and December 1937	Year 1936
Percent of all injuries	39.8	40.6	31.4	31.0	28.8	28.4
Percent of all poisonings	3.2	3.0	95.7	89.5	1.1	7.5
Percent of total admissions, injury, and poisoning titles	37.2	39.2	36.0	33.2	26.8	27.6

NOTE.—Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction" or "Alcoholism," as the case may be. Such cases are not included in the above figures.

MORBIDITY

Summary for the fourth quarter ending Dec. 31, 1937

Average strength	Forces afloat, 83,768		Forces ashore, 49,117		Entire Navy, 132,885	
	Admissions	Rate per 1,000	Admissions	Rate per 1,000	Admissions	Rate per 1,000
All causes	9,821	468.96	7,160	583.10	16,981	511.15
Diseases only	9,107	434.87	6,569	534.97	15,676	471.87
Injuries	701	33.47	510	41.53	1,211	36.45
Poisonings	13	.62	81	6.60	94	2.83
Communicable diseases transmissible by oral and nasal discharges (Class VIII):						
(A)	213	10.17	141	11.48	354	10.66
(B)	1,854	88.53	2,070	168.58	3,924	118.12
Venereal diseases	2,421	115.60	675	54.97	3,096	93.19

DEATHS

During the fourth quarter ending December 31, 1937

Cause		Navy			Marine Corps		Nurse Corps	Total
Primary	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
Average strength		9,820	2,223	102,028	1,336	17,074	404	132,885
DISEASE								
Appendicitis, acute	Peritonitis, general, acute.			1				1
Carcinoma, bronchus	Pneumonia, broncho-				1			1
Carcinoma, gall bladder	None	1						1
Carcinoma, larynx	do			1				1
Carcinoma, stomach	do			2				2
Cerebrospinal fever	Pneumonia, broncho-			1				1
Colitis, chronic	Dysentery, amoebic			1				1
Coronary heart disease, arteriosclerotic.	None			1	1	2		4
Dementia paralytica	Malaria, quartan (therapeutic).			1				1
Diabetes mellitus	Mastoiditis, acute			1				1
Diphtheria	Dilatation, cardiac, acute.	1						1
Encephalitis, hemorrhagica.	Pneumonia, broncho-	1						1
Glioma, brain	None	1						1
Hemorrhage, cerebral	Abscess, periproctic					1		1
Do	Arteriosclerosis, general.					1		1
Jaundice, acute infective (Weil's disease).	Pneumonia, broncho-			1				1
Leukemia	None			1				1
Meningitis, cerebrospinal	do			1				1
Do	Pneumonia, broncho-			1				1
Myocarditis, chronic	Thrombosis, coronary artery.	1						1
Do	Dilatation, cardiac, acute.					1		1
Pneumonia, lobar	None			1				1
Do	Pleurisy, suppurative			1				1
Sinusitis, ethmoidal	Abscess, brain				1			1
Status lymphaticus	None			1				1
Thrombosis, coronary artery.	Arteriosclerosis, general.			1		2		3
Thrombosis, cavernous sinus.	Cellulitis, face			1				1
Tonsillitis, acute	Septicemia			1				1
Tuberculosis, pulmonary, acute pneumonic.	None			1				1
Tuberculosis, pulmonary, acute general miliary.	do			1		2		3
Tuberculosis, pulmonary, chronic, active.	Hemorrhage, pulmonary.					1		1
Do	Tuberculosis, kidney			1				1
Typhoid fever	Hemorrhage, intestinal.			1				1
Ulcer, duodenum	Obstruction, intestinal, from external causes.			1				1
Total for disease		5		24	3	10		42
INJURIES AND POISONINGS								
Asphyxiation, acute, gasoline fumes (inhaled).	None			1				1
Avulsion, forearm (electric water extractor).	do			1				1
Crush, head	do			1				1
Drowning	do			4				4
Fracture, compound, ribs	Hemorrhage, pulmonary.			1				1
Fracture, compound, skull	None			4		1		5
Fracture, simple, skull	Intracranial injury			2				2
Fracture, simple, vertebra, cervical.	None			1				1

Cause		Navy			Marine Corps		Nurse Corps	Total
Primary	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
INJURIES AND POISONINGS—continued								
Intracranial injury	None			4		2		6
Do	Rupture, traumatic, liver.			1				1
Injuries, multiple, extreme.	None	5		15		2		22
Do	Alcoholism, acute			1				1
Do	Cystitis, acute			1				1
Wound, gunshot, chest	None					1		1
Wound, gunshot, abdomen.	do			1				1
Wound, gunshot, chest, and heart.	do			1				1
Wound, gunshot, head	do			3				3
Do	Psychosis, unclassified			1				1
Wound, gunshot, vertebrae, dorsal.	None			1				1
Wound, incised, neck	do			1				1
Wound, incised, wrist	Hemorrhage, radial artery.			1				1
Poisoning, acute, carbon monoxide.	None			1		1		2
Poisoning, acute, chloroform.	Psychosis, unclassified			1				1
Poisoning, acute, cresol	None			1				1
Total for injuries and poisonings.		5		49		7		61
Grand total		10		73	3	17		103
Annual death rate per 1,000:								
All causes		4.07		2.86	8.98	3.98		3.10
Disease only		2.04		.94	8.98	2.34		1.26
Drowning				.16				.12
Poisonings				.12		.23		.12
Other injuries		2.04		1.65		1.41		1.60

MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

Statistics for Fourth Quarter Ending December 31, 1937

The following statistics were taken from sanitary reports submitted by naval training stations:

October, November, and December 1937	U. S. Naval Training Station			
	Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	1,378	829	1,150	1,403
Recruits appearing before Board of Medical Survey	15	0	10	0
Recruits recommended for discharge from the service	15	0	10	0
Recruits discharged by reason of medical survey	14	0	(1)	0
Recruits held over pending further observation	0	0	(1)	(1)
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	(1)	18	95	61

[1] Not reported.

The following table was prepared from reports of medical surveys in which disabilities or diseases causing the surveys were noted existing prior to enlistment. With certain diseases, survey following enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Abscess, periapical	3	Malocclusion, teeth	6
Absence, acquired, lens	1	Metatarsalgia	1
Absence, acquired, teeth	5	Myopia	1
Acne, vulgaris	1	Myositis, chronic	2
Adhesions, abdominal	1	Nystagmus	1
Arterial hypertension	4	Osgood-Schlatter's disease	1
Arthritis, chronic, sacroiliac	1	Otitis, media, chronic	3
Astigmatism	1	Pansinusitis	1
Asthma	2	Pes cavus	1
Caries, teeth	7	Pleurisy, fibrinous, chronic	1
Color blindness	1	Psychoneurosis, hysteria	10
Constitutional psychopathic state, emotional instability	3	Psychoneurosis, neurasthenia	3
		Psychoneurosis, psychasthenia	1
Constitutional psychopathic inferiority, without psychosis	7	Psychoneurosis, unclassified	1
		Pyorrhea, alveolaris	1
Cyst, sacrococcygeal	1	Retinitis	1
Dacryocystitis, chronic	1	Rheumatic fever	1
Deafness, unilateral	3	Rhinitis, atrophic	1
Defective physical development	1	Somnambulism	2
Deformity, acquired, shortness of leg	1	Sprain, left elbow	1
Deformity, acquired, left wrist	1	Stammering	1
Deformity, acquired, chest wall	1	Strabismus	1
Deformity, acquired, finger, loss of flexion	1	Strain, muscle, thigh	1
Dislocation, articular cartilage, knee	1	Stuttering	2
Effort syndrome	1	Synovitis, traumatic, left knee	1
Epilepsy	6	Syphilis	2
Enuresis	21	Tonsillitis, chronic	1
Flat foot	8	Union of fracture, faulty	2
Foreign body, thigh (silver wire for treatment of fractured femur)	1	Valvular heart disease, combined lesions, aortic and mitral	2
Gonococcus infection, urethra	1	Valvular heart disease, mitral stenosis	2
Hernia, inguinal	1		

Volume XXXVI OCTOBER 1938 Number 4

United States Naval Medical Bulletin

Published *for the* Information of the Medical Department *of the* Navy

THE MISSION OF THE MEDICAL DEPARTMENT OF THE NAVY

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TO KEEP AS MANY MEN AT AS MANY GUNS AS MANY DAYS AS POSSIBLE

Issued Quarterly by the Bureau of Medicine and Surgery
Washington, D. C.

VOL. XXXVI OCTOBER 1938 No. 4

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NAVAL
MEDICAL BULLETIN

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THE MEDICAL DEPARTMENT OF THE NAVY

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

Owing to exhaustion of certain numbers of the BULLETIN **and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:**

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Volume X, 1916, No. 2.
Volume XI, 1917, No. 3.
Volume XII, 1918, Nos. 1 and 3.
Volume XXIV, 1926, Nos. 1 and 4.
Volume XXV, 1927, No. 1.
Volume XXVII, 1929, Nos. 3 and 4.
Volume XXVIII, 1930, No. 3.
Volume XXXIV, 1936, Nos. 1, 2, and 4.
Volume XXXV, 1937, No. 1.

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PREFACE

The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, and reports from various sources, notes, and comments on topics of medical interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

P. S. ROSSITER,
Surgeon General, United States Navy.

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The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received at least 3 months prior to the date of the issue for which they are intended.

The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized.

The BULLETIN intends to print *only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.*

EBEN E. SMITH, *Editor,*
Commander, Medical Corps, United States Navy.

In this the last issue of the BULLETIN which will appear prior to my retirement December 1, 1938, I take the opportunity to say farewell to my shipmates of the Naval Medical Corps. Whenever I have used the term "Naval Medical Corps" I speak of the Department as a whole; medical officers, dental officers, nurses, and hospital corpsmen, including not only the active service, but also our splendid Reserve.

When I became Surgeon General, nearly 6 years ago, I took the oath of office humbly and prayerfully, in the hope that I would be of use to the Country and to the Service which we all love. That prayer has been answered, not through me, but through you, for the Medical Department of the Navy has developed greatly during the last 5 years.

I am justly proud of having had the honor and distinction to have served as the head of our corps, for I speak judicially and informedly when I say that I believe it to be the finest medical service in the world. My pride is in nothing I have done, but in what the corps stands for, what it is, and what it is accomplishing.

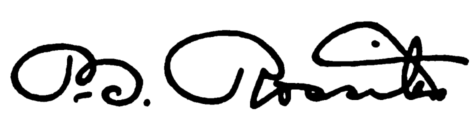
In every branch of the corps the loyalty, devotion to duty, and striving for betterment cannot humanly be surpassed.

Many officers, nurses, and corpsmen are my personal friends of long standing. All are known to me through their records.

I have been a member of the corps for nearly 36 years. I have enjoyed every minute of that service; I have enjoyed every duty to which I have been assigned. I will retire from active service with the keenest personal regret. Should there ever be occasion for my recall to active duty, I will welcome it.

I need not ask, for I know, that you will give my successor the same loyalty and assistance which you have given me in upholding the standard to which you have brought the United States Naval Medical Service.

May God bless each one of you.



U. S. NAVAL MEDICAL BULLETIN

VOL. XXXVI OCTOBER 1938 No. 4

SPECIAL ARTICLES

GASTRIC SURGERY[1]

A DISCUSSION OF THE PRESENT DAY TRENDS

By Commander FREDERICK R. HOOK, Medical Corps, United States Navy

Fifteen years ago, the surgical treatment of gastroduodenal ulcer was fairly well standardized. The chief controversy at that time was between the gastroenterologist and the surgeon as to which patients should be treated medically, and which should go to surgery. Today, there has been a realinement of the battling forces, with the gastroenterologist sitting snugly on the sidelines. For experience has taught him that certain types of peptic ulcer cannot be cured by medical means alone, and that any extended attempt to do so is apt to end in disaster. He, therefore, frequently turns to the surgeon for assistance. This has left the battle field cleared for the use of the surgeons. On the one side are alined the defenders, members of the old school, who favor what has become known as the indirect operations, such as pyloroplasty and gastroenterostomy. Their opponents, the invaders, belong to the newer school. They are the resectionists, and believe in more radical removal of pathology. The proponents of the old school are located in this and other English speaking countries, while headquarters for the new school has been in the German and Austrian clinics, with many converts in this country.

The literature has been so full of these arguments for the past few years that even those doing gastric surgery at times must become confused. For this reason a brief review of the more recent literature on the subject should be of interest. The basis for this present discussion is a report upon the gastric surgery done in the United States Naval Hospital, San Diego, Calif., during a recent tour of duty in that hospital. This covers a period of approximately 4 years. It has often been said that one learns more from his mistakes than his successes, so, if in headlining some of our more glaring mistakes we can prevent similar errors in the future, this paper will have served a useful purpose.

During this period 99 operations were performed on 90 patients. Ninety-six of these operations were undertaken for pathology in, or

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thought to be in the stomach or duodenum, the remaining three for lesions outside these organs. As might be expected the major part of the work was occasioned in the treatment of peptic ulcer, its complications and sequellae; 76 of the 90 patients falling under this heading. Malignancy was a poor second with only nine patients.

PERFORATION

Acute perforation of gastroduodenal ulcer is of common occurrence in the naval service. It is a condition that any medical officer may be called upon to treat at any time. Some writers have reported its frequency in as high as 7 percent of all peptic ulcers. It is the most dramatic of all acute surgical conditions and also the most remediable if treated early and properly. Given a patient, usually a male commonly with a history of stomach trouble, who has sudden, severe, agonizing pain in the pit of the stomach associated with shock, sweating, and boardlike rigidity of the abdomen, one needs little more to complete the picture. The shock usually subsides within a short while but the pain, boardlike rigidity and tenderness persist and are of such intensity that as a rule little difficulty is encountered in making the diagnosis, especially in the younger age groups. In older patients however, the diagnosis may be more difficult, as we will attempt to show later in a study of our deaths.

In this series there were 36 acute perforations. Thirty-five were due to benign lesions and one to a malignancy. Twenty-three perforations were on the duodenal side of the pylorus and 12 were on the gastric side. The malignant perforation was in the stomach. One perforation occurred in a gastrojejunal ulcer. The perforations were all on the anterior surface of the stomach or duodenum except the one due to carcinoma which was in the posterior wall of the stomach. The youngest patient was 20 years of age and the oldest 71. The average for this group was 41 years. Fourteen percent were under 30 years of age, 36 percent were in their 4th decade, 22 percent in the 5th, 17 percent in the 6th, and 11 percent were more than 60 years of age. In the five deaths due to benign lesion perforations the ages were, 31, 47, 61, 66, and 71 years respectively, an average of 55 years as against 41 years for the entire group. This would suggest that age is quite a factor in establishing the mortality rate. Age undoubtedly does play a part but probably only in an indirect manner. In the older patients, coronary, cholecystic, and pancreatic diseases are much more common and the diagnosis is frequently confused with these conditions, all of which delays the necessary surgery.

Seven patients (19.5 percent) gave no history of gastrointestinal symptoms previous to their perforation. The remaining had complaints ranging from 2 weeks to 17 years, and averaged 3.4 years. Of the 36 patients, 34 were operated. In two patients the diagnosis was

made only at the autopsy table. The time elapsing between perforation and operation ranged from 3 to 48 hours, and averaged about 11 hours. In the 3 fatal operative cases the time was, 19, 24, and 34 hours respectively. Three of the six fatal cases perforated while under medical treatment in the hospital. With surgery close at hand this would seem to be the ideal time to perforate. The records however, show that operation was delayed in two of the patients by tardy diagnoses, and in the third the diagnosis was arrived at only at the post-mortem examination.

On admission the temperature range in these patients was from 97° F. to 100.6°, 98.8° being the average. The pulse rates ranged between 78 and 120 and averaged 93. The systolic blood pressure was recorded as under 100 in only two patients. The leukocyte counts ranged between 5,600 and 24,900. Schilling differential counts ranged from normal to a marked shift to the left. In one fatal case in which the total leukocyte count was 5,600, the differential showed 96 percent granulocytes.

Nineteen patients had radiographic examination of the abdomen for pneumoperitoneum. Twelve showed a positive gas bubble and seven were negative. A positive radiograph confirms the diagnosis but too much dependence should not be placed on negative findings, as even with the best technique only about 80 percent show gas bubbles.

The amount of free fluid found in the general peritoneal cavity at the time of operation was estimated at anywhere from a few cubic centimeters to 800 cubic centimeters. The perforations as a rule were described as small, being under 1 centimeter in diameter. There were no multiple perforations. Moderate to marked induration about the perforation was the rule. Plastic exudate was frequently recorded. In the one patient in which drainage was instituted the surgeon did not give his reason for doing so.

In a few patients the ulcers were cauterized with the actual cautery previous to repair, but the majority of the lesions were simply closed by fine chromic gut sutures and then covered over with an omental patch. Owing to the marked scarring and induration about the pylorus, a partial gastrectomy was done on one patient and a gastro-enterostomy in conjunction with simple closure in a second patient. One patient in which a simple closure was done returned a few months later with obstructive symptoms and was relieved by gastrectomy.

The combined operative and nonoperative mortality rate in this series is 16.6 percent. In computing the operative mortality rate it is only fair that we exclude the perforated gastric carcinoma and the perforated marginal ulcer, as we know that both of these conditions give notoriously high death rates. The two patients that died without operation, naturally, cannot be included in operative statistics. We therefore have 2 operative deaths in 32 patients with acute

gastroduodenal perforations, a mortality rate of 6.25 percent. The average rate given in the literature is from 10 to 15 percent in patients operated under 12 hours, but some clinics report rates as high as 47 percent. Gatersleben and Zitzmann were able to reduce their mortalities from 31.5 to 21 percent by discontinuing gastroenterostomy in conjunction with the suture of the ulcer. Some of the central European clinics favor partial gastrectomy as the operation of choice in the treatment of acute perforations. Judin has reported the low mortality rate of 7.8 percent in several hundred resections. For the conservative operations he reports a mortality rate of 32.2 percent, and explains this by stating that gastrectomy was performed in the more recent cases and for the most part in young patients, while the conservative operations were performed on elderly patients in whom peritonitis was advanced. Primary gastrectomy was performed in over 80 percent of his patients with acute perforations.

There was a time when we thought that an acute perforation cured the ulcer. This undoubtedly does occur at times but symptoms continue only too frequently after perforation to call it "a blessing in disguise."

Following is a brief review of our six deaths following acute perforations:

Case No. 1. D. J. C.; Male, 31 years of age. Developed sudden, sharp, stabbing pain in upper right abdomen 18 hours previous to admission to the hospital. There was no history of previous gastrointestinal complaint. He had been seen by a physician shortly after onset of symptoms and given capsules without relief. At operation, 19 hours after onset, there was found a prepyloric perforation with green pea soup and fibrin in the general peritoneal cavity. Death occurred on the 16th postoperative day. Autopsy showed acute general peritonitis, subphrenic abscess which had ruptured through the diaphram into the base of the lung, lung abscess and pneumonia.

Case No. 2. I. Y.; Male, 61 years of age. History of stomach trouble for 10 years. He was admitted to the hospital on December 11, 1934, 2 days after a severe hemorrhage from the gastrointestinal tract. He did fairly well on medical management and in about 3 weeks a gastrointestinal X-ray study was made and reported upon as being negative except for gastroptosis, atony, and dilation of the stomach. On January 26, 1935, the patient complained of heartburn and got some relief by inducing vomiting. The following day he complained of cramps in the lower abdomen and marked muscular rigidity was present. Laparotomy showed a small perforation on the gastric side and about 800 cubic centimeters of fluid in the general peritoneal cavity. The patient died about 30 minutes after completion of the operation. Death was probably due to shock from the spinal anesthesia, superimposed upon an old cardiac lesion.

This patient was a stoical old Japanese whose reaction to pain was undoubtedly unlike that found in our average patient; however, when seen by the surgical consultant 24 hours after perforation, it was difficult to understand why the diagnosis had not been arrived at earlier.

Case No. 3. D. R.; Male, 66 years of age. Admitted to the surgical service of the hospital on December 3, 1934, with a diagnosis of gallstone colic. The patient had been perfectly well until the day of admission, when he was suddenly seized with a severe abdominal pain that felt as if something "burst" in his abdomen. Pain was aggravated by deep breathing or any change in position. The blood pressure was 96/58. The abdomen was diffusely rigid and there was exquisite tenderness over the gall bladder region and the epigastrium. The leukocyte count was 5,750 with a normal differential. He had had morphine previous to admission to the hospital and this was continued by the ward surgeon. After 2 days of observation he was transferred to the medical service, and 10 days after admission death occurred. Postmortem examination showed a perforated duodenal ulcer with generalized peritonitis and a large abscess in the right upper abdomen.

Morphine and the patient's age had much to do with confusing the diagnosis in this patient.

Case No. 4. J. H. K.; Male, 71 years of age. Admitted to the hospital on November 1, 1935, with a current gastro-intestinal complaint of about 2 weeks, duration. He had been nauseated for 2 weeks and had passed some tarry stools. He gave a history of a similar attack 2 years previously. A gastrointestinal X-ray study 6 months previous to this admission showed a third degree gastroptosis and visceroptosis but no ulcer. On the day of admission he had been awakened by pain and vomited coffee ground material. Upon admission his abdomen was soft and there was no tenderness or palpable mass. Three days later he complained of pain at 2 a. m. and this was controlled by amytal gr. 1½. Nine days after admission the patient had sudden severe pain in the epigastrium, accompanied by vomiting. This occurred at 10 p. m. He was seen by the officer-of-the-day who ordered ½ gr. of codiene by mouth. Forty-five minutes later he was still complaining and perspiring profusely and was given another ½ grain of codiene. One hour later ⅛ grain of morphine was administered by hypo. The following morning the abdomen was tender to palpation, especially in the left lower quadrant, but it was not particularly rigid. He was still complaining of abdominal pain and his general condition was not good. His temperature was 96.4 and the pulse rate was 120. The leukocyte count was 5,600 with 96 percent granulocytes. Supportive treatment was rendered and hypnotics given for pain, and on the following day the paitent died. Autopsy showed a perforated prepyloric ulcer with acute generalized peritonitis.

Here again we have age and hypnotics, plus a recent negative gastrointestinal X-ray study for ulcer, confusing the diagnosis. It is well to keep in mind that ptotics not only can, but frequently do have, ulcer, and that any belief to the contrary is entirely erroneous. Several writers have noted the absence of typical boardlike rigidity in perforation in the aged.

Case No. 5. A. J. J.; Male, 47 years of age. Admitted to the hospital September 13, 1934, with a history of current gastrointestinal symptoms of only 2 weeks, duration. Complained of constant epigastric pain without reference to the taking of food. Pain was gnawing in character and there was localized soreness to the left of the midline. A diagnosis of peptic ulcer had been made in 1926 on X-ray findings of spasm of the pylorus with a deformity of the lesser curvature. Two days after admission to the hospital he had severe abdominal pain for which he was given two injections of morphine. On the following day he continued to have severe abdominal pain and three injections of morphine were administered.

About 34 hours after onset of pain a surgical consultation was requested and at that time a typical boardlike abdomen was found. Upon opening the abdomen a large amount of fluid and plastic exudate was found, but an extended search by the surgeon failed to locate the perforation. The patient died 2 days later and autopsy showed a perforated gastric ulcer 3.5 centimeters in diameter located on the posterior wall. Pathological study of this ulcer proved it to be carcinomatous.

This patient was handled poorly from all angles. The ward medical officer and the officer-of-the-day erred in repeatedly giving morphine in the presence of severe abdominal pain and rigid abdomen. The surgeon erred in that, on finding fluid in the general peritoneal cavity typical of perforation, he did not explore the lesser peritoneal cavity.

Case No. 6. T. O. M. Male 51 years of age. Had had a gastroenterostomy 4 years previously. Was free of gastrointestinal symptoms for awhile but lately symptoms had returned. On the day of admission he developed severe upper abdominal pain and vomiting. He was operated shortly after admission to the hospital and a ruptured jejunal ulcer was found. The gastroenterostomy was unhooked, the ulcer repaired, and a tube inserted into the jejunum for the purpose of feeding. The patient died on the following day.

There is no criticism to offer in the handling of this case. Perforation of a jejunal ulcer is always a very serious condition and carries with it a high mortality rate.

Earlier in this discussion we stated that an attempt would be made to show that age in itself was not the chief factor in establishing the mortality rate in perforation, but that diagnosis was made with less ease in the older age groups. This contention I believe is proved, as 4 of the 6 patients were more than 50, and 3 more than 60 years of age. In three of these patients the finger points directly at hypnotics as a contributing factor in obscuring the diagnoses. One should never lose sight of the fact that morphine is an extremely dangerous drug to use in the acute surgical abdomen until the diagnosis is made, for frequently the average sized dose will bring about marked changes in the clinical picture.

One patient was operated upon for a chronic perforating ulcer and perigastric abscess. The perforation was closed and a posterior gastrojejunostomy performed. The patient made an uneventful recovery.

Before leaving the subject of acute perforation I would like to emphasize the importance of:

1. Early diagnosis and operation. The operative mortality rate will remain low in patients operated under 12 hours.

2. Simple closure of the perforation without resorting to further surgery at that time.

3. No drainage of the peritoneal cavity as it is not only unnecessary but increases the morbidity.

4. Judicious use of the stomach tube in the early postoperative treatment. If the stomach is kept empty there is little danger from

a blowout of a repaired ulcer, regardless of the amount of narrowing of the lumen of the gut.

GASTRECTOMY

The records show that during this same period 28 gastrectomies were performed. If less than 50 percent of the stomach was removed it was classed as a partial gastrectomy, if more than 50 percent, a subtotal resection. The postoperative diagnoses in these patients were: chronic duodenal ulcer 17, acute perforation of a duodenal ulcer 1, gastric ulcer 1, combined gastric and duodenal ulcer 2, carcinoma of the stomach 4, lymphosarcoma of the stomach 1, tuberculosis of the stomach 1, and diverticulitis of the duodenum 1.

These patients ranged from 21 to 59 years in age and averaged 39 years. The 4 carcinoma patients averaged 49 years of age. The patient with lymphosarcoma was 44 and the one with tuberculosis 25 years of age. The peptic ulcer patients gave histories of stomach trouble of 3 weeks to 24 years duration, and averaged 5.8 years. The 4 cancer patients had gastrointestinal complaints for 3 months, 6 months, 11 years, and 14 years respectively.

Of the 21 patients that had gastrectomy for peptic ulcer, 10 gave histories of having had single or repeated hemorrhages from the gastro-intestinal tract. Eleven had persistence of symptoms while under medical treatment. Two had had previous acute perforations, and 7 of the 21 had pyloric obstruction. Three of the four carcinoma patients had gastric retention. The type of operation employed was: Billroth I 1, Polya 3, Finisterer's resection for exclusion 5, and Polya-Balfour 19.

The amount of stomach resected in the duodenal ulcers was estimated at from 40 to 60 percent, and averaged about 50 percent, while in the gastric ulcers and malignancies it averaged about 80 percent.

In these 28 gastrectomies there were three operative deaths. Two followed resection for cancer, and one for a very large peptic ulcer located high on the lesser curvature of the stomach. One cancer death was due to an operative accident caused by a very friable gastrohepatic omentum, which made control of hemorrhage extremely difficult. The other cancer patient was doing well up to 48 hours and died suddenly from a pulmonary embolism. Death in the benign gastric ulcer patient occurred 100 days after operation. Following the operation he developed a pulmonary atelectasis, which in turn was followed by bilateral suppurative pleurisy, bilateral rib resection, and finally death from general sepsis. Although approximately 85 percent of his stomach had been resected, the remaining portion functioned well during his long illness.

Atelectasis, clinically demonstrable, was noted during the convalescence of four patients, pneumonia, in two, empyema in two,

poorly functioning stoma in three, and acute jejunal obstruction in one patient. Absence of free HCl or marked hypoacidity was a common finding following operation.

It is entirely too early in many of these patients to speak of end results, but the early results as a whole have been gratifying in resections for benign lesions. The immediate convalescence is usually quite smooth, especially if the stomach is kept empty with a Levine tube passed through the nose. This may be allowed to remain in continuously or the stomach emptied at frequent intervals. It is not unusual for patients to complain of fullness and nausea after meals, but this complaint persisted in only three of our patients. These patients were 23, 24, and 30 years of age respectively, and had had symptoms for only 1, 3, and 4 years. Many writers have noted the unsatisfactoriness of pyloroplasties and gastroenterostomies in the young, possibly this also holds true for gastrectomy. With our present knowledge it would seem inadvisable to offer surgery to this class of patients unless an emergency exists. Reoperation has been done in one of these patients with the establishment of a stoma between the afferent and efferent loops of the jejunum, which gave relief from symptoms. One patient in which a Polya type of operation was done developed an acute obstruction 3 weeks after operation, due to kinking of the proximal jejunal loop. At reoperation the loop was straightened out and a diseased gall bladder removed, following which the patient made an excellent recovery.

It is rather unusual that a case of lymphosarcoma should appear in such a small series as this, as it is supposed to occur in about the ratio of 1 to 150 carcinomas. This patient is in good health more than 2 years after resection and radiation.

The patient with tuberculosis of the stomach is of interest. He was a young man 25 years of age, whose chief complaint was intermittent vomiting of 6 months' duration. The X-ray showed a prepyloric ulcer with obstruction. X-ray of the chest was reported as being negative for lung pathology. Following a course of medical treatment the X-ray findings became more positive and malignancy was suggested. At operation an ulcer the size of a silver dollar was found on the lesser curvature of the stomach. Sections from this ulcer were first reported upon by the pathologist as being lymphosarcoma. A further study however, showed tubercle bacilli in the deeper structures of the ulcer, and a few months following the gastrectomy, small shotty inguinal glands appeared. Sections from these glands showed typical tuberculous lesions and material injected into guinea pigs produced tuberculosis in those animals. Gastric tuberculosis is seldom found in patients who do not have advanced pulmonary, osseous, or glandular tuberculosis. Eustermann and Balfour state that there has never been a proved case of primary gastric tuberculosis

reported. Fortunately, we were able to get a second roentgenologist to report a healed lesion in the right upper lobe of the lung, which relieved us of the burden of attempting to prove that the disease was primary in the stomach. It has been almost 2 years now since the patient's gastrectomy. He has regained his normal weight, works regularly, and is in apparent normal health.

GASTROENTEROSTOMY

Seventeen patients were subjected to gastroenterostomy; 15 were for peptic ulcer, 12 being on the duodenal side and 3 gastric. One was done as a palliative measure in an inoperable cancer, and the final diagnosis in the other patient was pernicious anemia. The cause for the gastric retention in this patient was not determined. In this group the patients ranged from 23 to 67 years of age, and averaged 44 years. As a group they were 5 years older than the gastrectomized patients. Gastrointestinal symptoms had been present on an average of 5 years. The indications for operation were given as:—gastric retention, induration and fixation of the duodenum and pylorus, poor condition of the patient which would make gastrectomy inadvisable, no improvement in complaint under medical treatment, hemorrhage, previous perforation, and inoperable carcinoma.

Sixteen of the gastroenterostomies were of the posterior no-loop type and one was of the anterior type. There were no operative deaths and satisfactory results were obtained in all but two patients. In the cancer patient the operation was purely palliative and the patient died after a few months. One posterior gastroenterostomy was a complete failure and had to be taken down and a gastrectomy done. No reason could be determined for its failure to function. Following gastric resection the patient made an excellent recovery.

MISCELLANEOUS OPERATIONS

In two patients simple excision of a peptic ulcer was done. One was for a gastric and the other a duodenal ulcer. Neither proved satisfactory. Symptoms were not relieved by excision of the gastric ulcer. The patient in whom a duodenal ulcer was excised, returned to the hospital in about 6 months with jaundice which was thought to be due to injury to the common duct at the time of operation. A cholecystgastrostomy was done, which gave relief for awhile, but the stoma closed off later and had to be reformed. The patient still has recurring attacks of jaundice and intestinal hemorrhages.

In one patient a Judd pyloroplasty was done without relief of symptoms. Frequently one is tempted to do one of these so-called minor operations to evade a more serious procedure, but their use generally has been disappointing, and they carry an operative mortality rate on a par with gastroenterostomy.

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Gastroenterostomies were un-hooked in four patients; once for perforated jejunal ulcer, twice due to vicious circle, and once because both the stoma and pylorus failed to function.

A gastrostomy was performed on one patient for the purpose of feeding and dilatation of an esophageal stricture following an attempt at suicide by drinking lye. Two patients were explored and found to have inoperable carcinoma of the stomach and nothing further done. In three patients the clinical history, laboratory, and X-ray findings pointed rather definately toward organic lesions in the stomach. However, exploratory incision into these stomachs failed to reveal pathology that would warrant gastric resection. In one patient the final diagnosis was chronic gastritis, in another hypertrophy of the gastric rugae, and in the third, subacute inflammation of the appendix. All returned to duty symptom free. Three cholecystgastrostomies were performed, two in the one patient mentioned previously following an injury to the common duct, and the third in a patient with cancer of the head of the pancreas.

Until someone discovers the cause of peptic ulcer, its treatment must rest entirely upon an empirical basis. Our aims at the present time are to relieve symptoms, to delay relapses, and to prevent complications. Cure is only problematical. When these conditions cannot be brought about by medical management, surgery is then to be considered. It is not always easy to know when this point has been reached. Lahey gives us six reasons for considering surgery in the presence of peptic ulcer. They are:

1. In patients with perforations.
2. In patients who cannot be relieved of distressing pain associated with ulcer.
3. In patients with ulcer in whom treatment with alkalis cannot be carried out because of the onset of alkalosis.
4. In patients with pyloric obstruction medically non-relievable.
5. In patients with serious recurrent hemorrhage.
6. In patients in whom the absence of malignancy in the lesion cannot be settled.

The chief argument at the present time is not so much when to operate, as what type of operation to employ, especially in chronic duodenal ulcer. The conservatives insist that resection of a large part of the stomach in the treatment of a lesion that is outside of that organ is entirely too radical. The resectionists counter with the statement that, only by resection can the gastric acidity be reduced and the incidence of jejunal ulcer lessened. Jejunal ulcer is and probably always will be the big bugaboo of all gastric surgeons. Just why there should be such a great variation in its frequency as reported by the various clinics is entirely unexplainable. Its frequency following gastroenterostomy has been reported in literature

as low as 2 percent and as high as 51 percent. Balfour gives it as 3.2 percent at the Mayo Clinic, Straus, as 20 to 30 percent at his clinic in Chicago, and Lewisohn of New York as 34 percent. Practically all of the central European clinics report high rates, and it is for this reason that gastrectomy has become so popular there. In Berg's clinic they were able to reduce the incidence of marginal ulcer from 34 to 7 percent by substituting gastrectomy for gastroenterostomy.

Although gastrectomy has been used for years in the treatment of gastric lesions, it was not until 1920 that Haberer introduced this more radical method of partial gastrectomy as the method of choice in the treatment of duodenal ulcers. If gastrectomy is to supplant gastroenterostomy it must answer two requirements: 1. The operative mortality rate must be no higher than in gastroenterostomy, and 2. The number of recurrent ulcers must be lower than in gastroenterostomy.

Operative mortality rates following gastrectomy have been reported as low as 1.5 percent but in most clinics the rate will probably run somewhere between 5 and 10 percent. The average mortality rate given for gastroenterostomy is 2 to 3 percent. Jejunal ulcer with its frequent complications is at times a formidable condition. Judd pointed out years ago the danger of depending upon medical treatment in this type of ulcer. Subtotal gastrectomy for the eradication of a marginal ulcer is accompanied by a mortality rate of at least 20 percent.

There is no question but that lower acid values are obtained in gastrectomy than in gastroenterostomy, but here again authorities disagree on why this occurs. Some contend that it is due to regurgitation of alkaline duodenal juices into the stomach, while others say it is due to resection of acid bearing portions of the stomach. Paggi concluded, after an extensive study both before and after gastroenterostomy and gastrectomy, that the lowering of the gastric acidity is due to modification of the gastric secretion produced by resection and not to neutralization of the secretion by the presence of bile or alkaline fluids backing up through the neostomy. The gastric hypoacidity is maintained for a long period of time and sometimes increases as time elapses.

The antagonists of gastrectomy point to the danger of so-called resection anemia developing as late as 5 or 10 years after extensive gastric resection. Manizade studied 40 patients in whom extensive resections had been done 5 to 12 years previously, and found that four (10 percent) had anemic blood pictures. Certainly this feature of gastrectomy cannot be entirely ignored and further studies along this line are in order.

Considerable diversity of opinion also exists as to the treatment of hemorrhage in peptic ulcer. The incidence of this complication has been estimated at 27 percent of all ulcers. Under medical treatment there is a mortality of about 1.5 percent. As the operative mortality rate in any type of gastric surgery is higher than this, conservative treatment would seem to be indicated. Keifer reports that 40 percent of his patients that had one hemorrhage failed to get good results from medical management. Where a second hemorrhage occurred, 80 percent failed to get satisfactory results. Most of the bleeding in ulcers arises from the pancreatoduodenal artery located in the posterior duodenal wall. We know that gastroenterostomy will not protect against further hemorrhage, and also that the location of these ulcers frequently makes resection extremely difficult. In acute hemorrhage the patient's age will frequently be the deciding factor as to whether emergency surgery should be performed, or conservative treatment carried out. The young patient will seldom die from hemorrhage, while the patient of 50 or over with arterosclerosis may easily do so.

There is little argument against gastrectomy in the treatment of prepyloric ulcers, as many of them perforate, and they frequently cause deformity and gastric retention. They do not do well following gastroenterostomy, and there is always the danger of their becoming malignant. Here again we meet with a wide diversity of opinions as to the relationship of gastric ulcer to gastric carcinoma, for McCarty considers 68 percent of gastric ulcers as forerunners of cancers, while Wilensky and Thalheimer think it is as low as 1 to 2 percent. On examination of a large series of gastric ulcers removed at operation, Stewart found malignancy in 9.5 percent, Pauchet in 15 percent, and Finisterer in 26 percent. Hinton and Trubek, after studying a large series of cases over an 8-year period of time, came to the conclusion that about 5 percent will show malignant changes. Others believe that about 30 percent of all prepyloric ulcers become malignant as against only 2 percent in the corpus. Two of our gastric cancer patients gave histories of having had gastrointestinal complaints for 11 and 14 years respectively. There is no proof that malignant degeneration occurred in preexisting prepyloric ulcers in these patients, but it is easy to believe that such might be the case.

The problem of what to do with the chronic callus ulcer about the pylorus and first portion of the duodenum is at times quite trying. This is the type of ulcer that causes marked scarring and deformity, and frequently causes gastric retention. Technically, gastrectomy in some of these patients is extremely difficult and frequently inadvisable, as irreparable damage may be done to the pancreas, its ducts, or to the common bile duct. At times it is impossible to get enough of a normal duodenal stump to infold after resection. The ideal

operation for this type of lesion is the "resection for exclusion" of Finisterer. With it no attempt is made to resect that portion of the viscus in which the ulcer is located. The antrum with a portion of the body is resected with the idea of lowering the acidity. A primary mortality rate in this type of operation has been reported by Friberg as 4.4 percent, as against 12.6 percent for the radical resections. Permanent results were obtained in 87.7 percent, which was as good as with the radical resection and better than with gastroenterostomy.

Gastroenterostomy undoubtedly has a place in the treatment of peptic ulcer, and certainly much of the blame that has been heaped upon it for causing jejunal ulcers should be placed where it belongs, that is, on the surgeon. It is a fairly simple operation to do, but is frequently done poorly, and in patients where the indications for it do not exist. The ideal place for gastroenterostomy would seem to be in the patient beyond 50 years of age, who has few active symptoms and a fairly normal acidity. In this type of patient the symptoms are frequently due to gastric retention from a healed ulcer about the pylorus. One such patient in this series gained 60 pounds in weight during the 2 months following his operation.

There is no place in surgery where individualization is more desirable than in gastric surgery. Each case should be entered upon with an open mind, and the choice of operation deferred until the abdomen has been explored. The surgeon, then, should have the ability and experience to carry out the work indicated.

Time will not permit more than a brief mention of the salient features in the preoperative preparation and the postoperative treatment of these patients. The preoperative features that appear most important are:

1. Correction of dehydration, if present.
2. Gastric lavage in patients with retention.
3. Transfusion in hemorrhage patients.

It should be remembered that a poorly managed preoperative or postoperative regime may vitiate the most brilliant surgery.

The outstanding features in the postoperative care are:

1. Sufficient morphine to keep the patient comfortable.
2. Use of the Levine stomach tube, either continuously or at frequent intervals for the first 2 or 3 days.
3. Administration of large amounts (3,500 to 4,000) cubic centimeters of glucose and saline solutions parenterally for 4 to 5 days.
4. Transfusions following extensive operations.
5. Frequent changes of the patient's position in bed to prevent pulmonary complications.
6. Pulmonary hyperventilation by using carbon dioxide rebreathing bag frequently for the first 48 hours.
7. Judicious feeding under the direction of the gastroenterologist.

SUMMARY

Many writers now consider peptic ulcer as nothing more than a local manifestation of a systemic disease. The subject is so complex that few hard and fast rules, generally applicable, can be laid down for its therapy. Certainly, surgery must be classed only as an adjunct, and has no place in the therapeutic regime until all medical means of controlling the disease have been exhausted. This means that a fairly small percentage of all ulcers eventually come to surgery.

The chief role that surgery has to offer appears to be in the reduction of gastric acidity and the relief of gastric retention. Gastroenterostomy fails to do the former in many cases, and it is probably due to this reason that it has been found wanting. On the other hand, by resection of large portions of the body of the stomach, hypoacidity or anacidity can be brought about. This would seem to be the nearest approach to, if not the ideal surgical, treatment at the present time.

There is always a veil of enthusiasm that helps to obscure the real facts in any new method of treatment. The present popularity of gastrectomy is no exception. The resectionists, by experience and refinement of operative technique, have markedly reduced the mortality rate in gastrectomy, but the questions of permanence of cure and the occurrence of late resection anemia have not as yet been answered to the complete satisfaction of the conservatives. One might reasonably prophesy that, when all of the facts are in and the final analysis is made, there will be ample room in the surgeon's kit-bag for both gastroenterostomy and gastrectomy, and that the wise surgeon will be the one who knows how, and when, to make use of both.

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THE SURGICAL GALL BLADDER[1]

By Commander M. D. WILLCUTTS, Medical Corps, United States Navy

The trend in the management of the diseased gall bladder (and gallstones) has changed sharply during the past 5 years. In the majority of American surgical clinics, early and complete surgical intervention is becoming the procedure of choice. Formerly considered a medical or an interval surgical problem, an attack of acute cholecystitis, with or without stones, is now widely rated a major surgical emergency. Prolonged medical treatment for cholecystitis invites liver damage and leads to serious postoperative morbidity. Early surgical intervention gives no greater mortality than that of routine gall-bladder surgery and reduces to a remarkable degree the mortality and morbidity arising from complications incident to delayed surgery.

The gall bladder is an organ of digestion that functions in health as a reservoir for bile. During this period of storage, the bile is concentrated as much as eight times its original specific gravity. In response to demands of normal fat and protein digestion, the gall bladder supplies bile in timely jets thus providing rich bile and aiding in maintaining continence in the common bile passage.

The temperate individual, he who eats and drinks sanely, may enjoy his gall bladder and healthy digestion indefinitely throughout life. He will know and appreciate the pleasure of good digestion, the relish for simple foods and the strength and force derived from them, and finally the unexcelled satisfaction of a normal daily bowel movement resulting from good biliary digestion.

Now let disfunction ensue and liver function become impaired. Enjoyment of living is seriously affected. The causes may be many. The chief predisposing factors are sedentary habits of advancing years, the consumption of unnecessarily large quantities of food, gouty tendencies, certain systemic infections, as typhoid, and conditions which delay or interfere with the emptying of the gall bladder. Associated gastrointestinal lesions, such as chronic appendicitis, splenic disorders, and chronic heart disease definitely predispose.

The gall bladder becomes diseased. Ordinarily we accept the term cholecystitis to denote inflammation secondary to infection. Judd proved that metabolic factors free of infection may also produce the same syndrome of disfunction. Infection reaches the gall bladder by direct extension through the ducts from the intestines, by the systemic circulation via the hepatic artery and portal vein, and by lymphatic extension from the liver to the walls of the gall bladder. DaCosta taught that healthy bile is sterile and that when bacteria are found in the bile the condition is one of disease. Usually the bile becomes infected secondary to gall-bladder infection.

[1] Read at the Staff Conference, U. S. Naval Hospital, Washington, D. C., on December 3, 1937.

In disease, the gall bladder rapidly loses its muscular tone, the bright sheen of health becomes lusterless, the walls are flabby or shrunken. The normal emptying power is lost, bile stasis results. The predisposing factors for the formation of gallstones are now present. If infection is the main factor in the cholecystitis, stones will be multiple and often pigmented and layered. If the pathological changes are of metabolic origin then the single cholestrin stone occurs. This type of stone arises from an excess of cholestrin commonly seen in pregnancy, diabetes, arteriosclerosis, jaundice, general obesity, and chronic interstitial nephritis.

Gallstones are not rare. DaCosta estimates that 25 percent of all females beyond 65 years have gallstones. Germany reports stones in 12 percent of all post mortems. Women who have borne children are far more liable than those who have not. Breast feeding the baby is said to curtail sharply the incidence.

Waterhouse [2] 30 years ago observed that total abstainers (from alcohol) seem to possess a greater predisposition than the users of alcohol, probably because the abstainers are more apt to be larger eaters.

A stone may be silent and give no colic. Then sudden muscular exertion, external pressure, or the onset of a fresh inflammation may dislodge it and cause it to descend. A very small stone may pass freely. A larger stone in passing gives violent colic. A still larger stone remains in the gall bladder or becomes fixed in the cystic duct or lodged in the common duct. The possessor of such a gall bladder now presents the picture of a progressive dyspeptic. Constipation develops, flatulence, loss of appetite, especially for certain foods. Deaver often stressed the early intolerance for raw apples. Migraine, upper abdominal distress of varying degree of intensity, and a sallow complexion are noted. Masked symptoms and signs of associated visceral damage confuse the clinical picture. The cholecystic heart develops (not unlike the masked thyroid heart), kidney damage is noted, and psychogenic changes, melancholia, literally black bile, occur. Many think they have stomach trouble and complain chiefly of indigestion, flatulence, pain after eating, pyloric spasm, and often they become aspirin and soda-bicarbonate fiends. The above are indirect symptoms bearing no true relation to the size or number of stones. The active classical symptoms of gallstone occur only when infection flares up, when the ducts are occluded and cease to drain, or when a stone starts to pass. Thus the condition of chronic cholecystitis with or without stones, in the absence of colic due to inflammatory flare-ups or to stone movements, may give strikingly similar group pictures of dyspeptic unhappiness. This is the period for prophylactic treatment. The gall bladder is now only potentially

[2] Waterhouse: Lancet, May 8, 1909.

surgical. Failure, however, to respond to medical measures portends serious progression of pathological changes and renders the condition definitely surgical. Unrelieved, a chronically diseased gall bladder suffers sooner or later an attack of acute inflammation, a major surgical condition attended by serious morbity and an alarming death rate.

The dyspeptic patient seeks medical aid early. The medical man, alert to the causative factors of gall-bladder disease, will attempt correction and resolution of the sick organ. He faces a difficult task. The intemperate patient balks at dieting, soon loses patience, and fails to cooperate. The gallstone of metabolic origin may resolve or pass, but here also predisposing and causative factors, long present, are difficult to adjust. The chronically infected gall bladder is most resistant. Skilled men like Lyons, of Philadelphia, employ duodenal syphonage to drain the gall bladder. With the perfected technique of highly trained doctors and nurses this method has succeeded in arresting cholecystitis and has restored the gall bladder to some degree of function. In the hands of the general run of doctors, this type of drainage is not successful and usually depletes only the poor victim's pocketbook. At any time the patient faces the sudden crisis of gallstone colic or the agony of an acute inflammatory spasm. Associated visceral damage, pancreatitis, ulcer, or regional hepatitis weaken the patient's reserve strength. The heart and kidney functions become impaired. Mental symptoms of a toxic psychosis may occur. Medical management of such a condition is now futile and may even prove disastrous. The delay incident to symptomatic treatment may permit extension of the infection into the common duct, start the formation of stones in the main biliary tree with attending grave liver damage and most difficult surgical pathology.

And still the poor victim will continue his search for medical relief. Even in well-regulated hospitals rarely do we find the gall bladder case admitted directly to the haven of the surgical ward. He falls to the medical man and is subjected to a check-up incident to a complete physical examination and clinical observation, blood pictures, sedimentation tests, X-ray series, renal function, stools for parasites, X-ray of chest for chronic pulmonary pathology, electrocardiograph, and basal metabolic tests. A marvelous chart of collateral information is collected revealing evidence of visceral damage that may only confuse the basic gall-bladder pathology. My remarks may appear a bit caustic; they are not to be applied specifically, for certainly the closest medical and surgical cooperation obtains in our Navy. But in general terms, I do decry the serious delay commonly found in the medical management of advanced gall-bladder disease.

The surgical consultation arrives. What do we find?

GALLSTONE COLIC

The bedside picture is familiar to all. No pain, not even childbirth pains, may be so acute. The sudden onset, usually hours after a hearty meal, absence of fever and leucocytosis, presence of gastric upset, abdominal distention, restlessness, and characteristic pain radiating to back and right shoulder blade are classical symptoms. There is usually no jaundice (less than 20 percent), no chills or sweating. The outstanding feature is pain, violently sharp, but not prostrating. The treatment is sedation, morphine in maximum doses combined perhaps with nitroglycerine or pearls of amyl nitrite.

Keeping in mind the simple rule that gallstones give rise to colic only when infection occurs, or when the ducts become occluded and cease to drain, or when a stone starts to pass, symtomatic treatment is rational only when directed surgically, because of the serious potentialities ever associated with gallstones. The dangers are real. Warning signals of the extension of gall-bladder colic into an acute inflammatory process may be clear or obscure. Definite signals are chills and fever, malarial-like reactions, which Moynihan [3] termed the "steeple chart"—sudden elevation, precipitate descent, with complete intermissions. There is leucocytosis, often above 20,000. The gall-bladder region is tense or rigid, abdominal surface edema may be present, and tenderness to palpation on inspiration is exquisite. Jaundice is not the rule; was absent in 80 percent of DaCosta's cases. It may develop slowly following the subsidence of the acute colic, this the result of blocking of the common duct by posttraumatic edema from passage of the stone. The pulse gives no constant picture—the slowed pulse may indicate pancreatitis. Moynihan [3] states: "There is no reduction in the pulse rate due to jaundice unless a degree of chronic pancreatitis exists."

Such a patient is seriously ill and looks it. Surgery is definitely indicated. No longer is accepted the old theory that stones, even after resolution of such a picture described, may become silent and cause no further trouble. There is no tendency whatsoever to spontaneous cure. Stones once formed remain, unless passed. Medicine cannot reach them to dissolve them except by direct introduction of a solvent through a surgical T-tube. Early operations are safe and comparatively easy, less dangerous than the passage of a stone through an inflamed duct. Complications are lessened or avoided entirely by early surgery. The operation of choice is cholecystectomy.

ACUTE CHOLECYSTITIS

This condition presents a far more urgent surgical problem. The main etiological factor is usually a chronic gall bladder, with a stone

[3] Moynihan: Gallstones and Their Treatment.

or stones nursed along for years only to become impacted in the cystic duct, so that edema, congestion, necrosis, and at times perforation results. A milder form, but still surgical, develops without stones. This is due to inflammation secondary to infection, usually of low-grade virulence and often of long standing.

The bedside findings of acute disease of the gall bladder may vary widely from mild to severe symptoms. Fully 10 percent will not present acute symptoms at time of admission to the hospital. Afebrile, normal blood picture, usual digestion, the surgical diagnosis in this group must be established by careful past history, clinical judgment, and X-ray findings of non- or poorly-functioning gall bladder. This 10 percent, clinically mild, may reveal startling gross pathological findings at operation or autopsy.

The severe cases are marked by sharp abdominal pain, tenderness, rigidity, and superficial edema limited to the gall-bladder region. Jaundice may be present and is a serious omen of impending perforation or gangrene. Chills occur frequently. Often a palpable mass is noted, indicating empyema or hydrops. Temperature reactions vary, are never constant, and fail to indicate the severity of the attack. Leucocytosis ranges from high normal white count to 25,000 or more. The blood findings, however, are never constant. In fact no constant factor occurs that will indicate the severity or extent of the gall-bladder lesion. Perforations occur far more frequently than was formerly thought. Kunath [4] reports 22 percent with perforations in 103 cases in a recent series collected at the University Hospital of Iowa. Fortunately most perforations of the gall bladder are limited in extent and are usually adequately encapsulated by adhesive plugging by the gastrohepatic or colic omentum.

It is now generally accepted that acute cholecystitis endangers adjacent organs. Varying degrees of pathological change may be found in the common duct, pancreas, and liver. The pathological findings usually exceed the clinical symptoms. Frequently the clinical manifestations of the disease are subsiding while the gall bladder continues its progress to empyema, gangrene, or perforation. Observations from our great clinics reveal that a patient with acute cholecystitis has but one chance in three of having resolution of the pathological process in the gall bladder.

The trend to operate early for acute cholecystitis is sweeping the country. Only 4 years ago the policy of most American surgeons was postponement of operation for acute cholecystitis until the acute inflammation had subsided or rather until the acute symptoms had quieted, provided the clinical picture showed a tendency to improve, and the objective signs remained confined to the right hypochondrium.

[4] Kunath: Surgery Genecology and Obstetrics, vol. 65, July 1937.

There were a few outstanding exceptions—notably Erdman, Walton, and Kirschner, who courageously advocated immediate operation. The trend today is early or immediate operation.

Charles Gordon Heyd, in the leading editorial of Surgery Gynecology and Obstetrics, October 1937, makes a striking plea for immediate operation. He refutes the old law that operative mortality in acute cholecystitis is prohibitive and stresses that to delay operation is to gamble with odds overwhelmingly against you. He states:

Increasing statistics demonstrate forcibly that the operative mortality in patients who are operated upon in the early stage of acute cholecystitis is not greater than that which obtains in routine gall-bladder surgery. Furthermore, the high mortality, of approximately 20 percent, that occurs after late operation is largely the mortality that arises from the complications—empyema, abscess, gangrene, and perforation—and, when operative recovery finally takes place, there remains the permanent damage to liver and associated organs with continued morbidity.

Stone and Owings,[5] of Baltimore, advocate immediate operation:

We think that by prompt operation there is a notable saving of time, pain, expense, and danger as compared with the policy of delay. * * * Not only do we regard the acute gall-bladder lesion, whether hydrops, empyema, torsion, gangrene, or simple acute cholecystitis, as best treated by prompt operation, but, again contrary to general opinion, we believe that in most cases the operation should be a cholecystectomy.

Judd, Phillips, and Walters,[6] of Mayo Clinic, endorse early operation with reservations:

Although we wish to subscribe to the plan of early operation in acute cholecystic disease, and although this coincides with the opinion expressed in the more recent literature on the subject, nevertheless we feel that there are certain instances in which surgical treatment should be postponed. In some cases it should be delayed for a long time. In caring for these patients it will be necessary to consider each one as presenting an individual problem. There is no set plan that will fit all cases. * * * Cholestectomy will not be permissible in every case, but this procedure should be carried out whenever feasible. * * * No one would feel that a deeply situated, inaccessible, acutely inflamed gall bladder should be removed from an extremely sick person. Cholecystostomy may be all that is warranted.

Dr. Fred B. Lund,[7] of Boston, states:

That when I wait for cholecystitis cases to subside I have many times been disappointed, because they gradually got worse.

Dr. R. H. Miller,[8] of Massachusetts General Hospital, agrees with Drs. Stone and Owings:

That in those in which more procrastination had taken place there was a higher mortality, whereas in those instances in which operation was performed early the mortality was less.

[5] Stone, H. B., and Owings, J. C.: The Acute Gall Bladder as a Surgical Emergency. Tr. Am. Surg. Assn., 51: 281–286, 1933.

[6] Judd, E. S., and Phillips, J. R.: Acute Cholecystic Disease. Tr. Am. Surg. Assn., 51: 292–297, 1933.

[7] Lund, F. B.: Discussion. Tr. Am. Surg. Assn., 51: 297–298, 1933.

[8] Miller, R. H.: Discussion. Tr. Am. Surg. Assn., 51: 298, 1933.

Dr. Hubert A. Royster[9] supports the theory that early operation is the procedure of choice.

Dr. Morris K. Smith,[10] of New York, sounds a warning note:

> I have been impressed with the favorable postoperative course of patients subjected to early cholecystectomy and have operated before the fever subsided in a majority of my own cases without feeling that an error of judgment had been made until rather recently, when an obese woman of 52, who had had several attacks, succumbed 2 days following a partial cholecystectomy, with a rapidly rising temperature and failing circulation. * * * Patients with acute cholecystitis should not be operated on, immediately upon admission, without an urgent indication. The surgeon should be ready to intervene promptly if progress is unfavorable. Younger patients in good condition, after a day or two of preparation, may be operated upon without waiting for the attack to subside. In poorer risks, if the course under observation is satisfactory, it is wiser to allow the acute attack to cool off.

At the 1936 meeting of the Southern Surgical Association, Dr. Heuer called attention to the marked reduction in the operative mortality of acute cholecystitis since the institution of early surgical treatment.

Dr. Frank Lahey[11] states:

> If gallstones while in the wall of the gall bladder were destroyed, there would be fewer patients with common duct stones, fewer patients with infection of the biliary tract, the mortality would be lower, the number of recurrent common duct stones lessened. and the completeness of the recovery greatly added to.
>
> Physicians should urge operation upon patients with gallstones, providing their condition permits, as soon as they are demonstrated. They should be demonstrated earlier, and certainly no patient without a fair understanding and a frank warning as to the consequences should be permitted to pass through repeated attacks of gallstone colic. No operation should be done for cholelithiasis without thorough investigation of the biliary tract and removal of any possible common or hepatic duct stones.

We have in the Navy better control of our patients than is usually seen in civil life. Hospitalization is instituted early and facilities for complete check-up are readily available. This permits prompt diagnosis and surgery in the early optimum phase. Decision for immediate operation or postponement for a few days may rest upon a sensible estimation of the situation. Associated visceral damage should be known so that impaired heart, liver, pancreas, and kidney function may be spared excessive additional operative load. If delayed surgery must be resorted to in order to spare additional visceral damage, then the prognosis is always guarded.

Preoperative preparation is very important; the fluid balance must be checked within normal limits. Sugar is important and may be given as candy, honey, sweetened fruit juices, or intravenous glucose. The gall bladder should not be denied fat completely. Preoperative diet should include fat and protein as well as sugar so that biliary stimulation may approach normal digestion.

[9] Royster, H A.: Discussion. Tr. Am. Surg. Assn., 51: 299, 1933.
[10] Smith, M. K.: Treatment of Acute Cholecystitis. Tr. Am Surg. Assn. 51: 287-291, 1933.
[11] Lahey, F.: Surgical Clinics of North America. June 1937.

The choice of anesthesia must be carefully considered. Spinal or regional block and local infiltration give the greatest safety in the difficult and serious risk cases. Combination of basal anesthesia, avertin with regional block, or gas inhalation is safe. Most of the cases tolerate well basal avertin and inhalation anesthesia.

The postoperative reactions demand immediate attention. Postoperative crisis in surgical treatment of acute gall bladders are marked by early high fever, failing circulation, and pulmonary edema. This condition is rapidly fatal unless failing circulation can be supported. Glucose infusions and blood transfusions are indicated and must be employed heroically. The easiest reactions and best results usually occur in those patients having gallstones and severe pathological lesions. Surprisingly stormy reactions and poorest results are found in those patients having mild or catarrhal chronic cholecystitis. This latter group fortunately constitutes only 10 percent of the general run of cholecystectomies. If abdominal distention occurs, employ promptly the Wangensteen siphonage. Its routine use in difficult cases will add great comfort and safety. Biliary drainage will be improved and restoration of liver function hastened. Safe body chemistry must be maintained by intravenous glucose and salines given freely. A practical index is a daily urinary output maintained at above 1,000 cc. Calcium chloride in small amounts is recommended by Graham [12] for liver damage following postoperative gall-bladder care. Morphine sedation is indicated for pain or restlessness. A bland but balanced diet is permitted early, the patient's own desire and appetite governing the selection.

CONCLUSION

Plea for assignment of gall-bladder diseases to the surgical service is made, the acute conditions being considered as acute surgical abdomens. Gallstones are stressed as surgical lesions, their early removal affording safest prophylactic measures against biliary tree infection.

Prompt surgical intervention is urged in acute cholecystitis providing safety factors exist, chief of which is good metabolism as indicated by blood chemistry and kidney function, conditions usually found in the first 48 hours of the attack. Operative difficulties and postoperative complications mount rapidly after second and third day of the disease. Danger of perforations as against postoperative crisis due to decompensated liver, pancreas, and kidneys must be carefully weighed.

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[12] Graham, E. A.; Illinois Med. Journal, 63: 196, September 1931.

ACUTE HEMORRHAGIC PANCREATIC NECROSIS [1]

A REVIEW WITH CASE REPORTS

By Lieutenant A. R. Higgins, Medical Corps, United States Navy

The discussion of hemorrhagic necrosis of the pancreas appears timely, especially because of certain newer ideas of its pathology and critical evaluation of therapy advocated in its attempted cure. A review of recent views on the subject leads one rapidly to the conclusion that there is still much information to be desired concerning this most catastrophic of intra-abdominal accidents.

The clinical picture of hemorrhagic pancreatic necrosis was described first by Fitz in 1889, and many workers have since attempted to explain the etiology, pathology, and especially the diagnosis and treatment. The results, as expressed in current writings, have been disappointing. There is evident a dissimilarity of views concerning even the exact pathological states to which the term pancreatic necrosis may be applied. Especially is this true in the statistics of operative mortality where some authors appear to be discussing the milder forms, showing edema, or patchy necrosis or hemorrhage of the pancreas, while others are obviously reporting the results of surgery in more fulminating and clinically overwhelming types. A very considerable statistical error must be present in the reported results of any individual surgeon because due to infrequent occurrence of the syndrome the statistical method suffers from lack of numerically sufficient cases.

The etiology of acute pancreatic necrosis has been debated at length by Opie, Archibald, Mann, Giordano, and others. It is generally agreed that the histopathological picture is the result of the action of an irritant on pancreatic tissue, and it appears reasonable to suppose that the irritant involved is developed from that which is always potentially present in the pancreatic substance; namely, trypsin, from pancreatic trypsinogen. The activation of trypsinogen into trypsin, normally brought about by enterokinase in the gut, is not explained. Experimentally, it was shown by Archibald that liver bile without the cholecystic mucin, or heavily infected bile, caused a lesion resembling human pancreatic necrosis.

Obstruction of the ampulla of Vater with a resulting back-up of bile into the pancreatic ducts, was the first attempt at explanation. At post mortem, however, blocking of the ampulla has been rarely shown. More recently the matter was investigated by Archibald, who found that spasm of the sphincter of Oddi could be induced experimentally. Mann and others, however, reported that in a relatively greater number of cases this explanation was untenable because the sphincter was proximal to the opening of the bile ducts.

[1] From the Surgical Service, U. S. Naval Hospital, San Diego, Calif.

Deaver's concept of the spread of infected lymph from the gall bladder to the pancreas has lacked anatomical proof.

Interesting is the observation made by Boyd and others that the onset of symptoms has frequently followed a heavy meal. In at least one of the cases covered by this report, the patient had been on an extensive alcoholic debauch, showing an appreciable amount (1.5 mg) of blood alcohol.

The morbid anatomy of the condition is variable and appears to extend over the milder grades of edema, scattered patchy necrosis or hemorrhagic areas, through massive death, with or without hemorrhage of a large part, or the entire organ. The pancreas is usually enlarged, firm in the milder types, and becoming soft and friable in the more severe grades. The surface shows areas of fat necrosis, areas of hemorrhage, or it may be black and gangrenous. Microscopically there is extensive necrosis of pancreatic parenchyma. Sequelae may be resolution to integrity in the less severe types, or suppuration or so-called pseudocysts may occur.

A very constant finding at laparatomy is the presence of serosanguineous fluid in the omental bursa or peritoneal cavity. The diagnosis of pancreatic necrosis is at all times difficult, particularly in those cases not sufficiently severe to present the classical signs, and it is only in these cases that therapy appears of larger value. The syndrome will undoubtedly be diagnosed more frequently with a more widespread knowledge of its character, especially in the less severe types.

The classical picture is that of acute abdominal pain, of a steady, excruciating type, more terrible than that of a perforated ulcer, rapidly developing vomiting and cyanosis and other evidence of a toxemia. The location of tenderness in a well circumscribed area above and to the left of the umbilicus has been highly suggestive of the condition.

Archibald has noted a characteristically later appearance of rigidity in comparison with the only serious difficulty in differential diagnosis, a ruptured ulcer, a fact which he explains by the retroperitoneal location of the lesion.

The test of Loewi, of securing mydriasis with instillation of adrenalin is reported as of value in the absence of thyrotoxicosis.

Many writers have noted that a hyperglycemia is a fairly constant finding. The stools may become fatty and bulky from loss of pancreatic ferments.

The various tests for diastase, in the blood, urine, and duodenal contents, have been disappointing. The Todd modification of the Wohlegemuth technic for blood or urine diastase estimation is believed to be of value in cases where a laboratory is sufficiently well equipped.

At laparotomy, the appearance of fat necrosis, the patchy yellow-white deposition of fatty acids in the splitting of fats by lipase, is pathognomonic.

Roentgen examination for pneumoperitoneum is of value in differential diagnosis, particularly in excluding a perforation of the gut.

A leucocytosis is present, ranging from 12,000–30,000 and certain writers attach a prognostic significance to changes, a sudden increase to 30,000–35,000 indicating a bad prognosis.

In view of these conflicting and certainly far from definite views as to etiology, pathology, and symptomatology, it is not surprising that scarcely any writers are in accord as to the therapy of choice. Archibald and others, following the basic belief that a blockage at the sphincter of Oddi is the important etiological factor, report their best results following drainage of the biliary tract by cholecystostomy. Most adherents to this idea also include tamponade drainage of the pancreatic bed through the gastrocolic ligament.

Other writers, notably the American group, have tended toward conservatism. Whipple outlines this plan of therapy with the view that, given a reasonably definite diagnosis of pancreatic necrosis, operation should be deferred for a few hours, until shock is overcome and the electrolytic balance of the blood restored by saline infusion. In many patients, this improvement is marked, and localization of the lesion, with recovery, or a less serious lesion, develops.

If conservative therapy does not give an improved picture, then operation is indicated. The operative treatment advised by Whipple is essentially drainage of the lesser sac with no attempt at drainage of the pancreas unless it can be done with the finger by blunt dissection.

An examination of the gall bladder and ducts is made, and drainage of the gall bladder is believed justified if the condition of the patient and the ease of procedure warrant.

Jones, quoted by Whipple, cites the following significant figures, collected in 1922–24, of 56 cases, with 60.7 percent gross mortality:

	Cases	Severe	Mild	Deaths	Mortality
					Percent
No operation	6	6	0	6	100
No drainage or drainage of abdominal cavity	14	10	4	12	86
Drainage of pancreas, including abscess	29	25	4	8	28
Drainage of pancreas without abscess	20	18	2	11	55
Drainage of abscess alone	9	7	2	0	0
Drainage of biliary system	3	2	1	2	66
Drainage of biliary system and pancreas	3	2	1	3	100

Here again the large factor of statistical error must be borne in mind. Writers in most cases fail to classify their cases as to severity, and this fact must greatly influence a statistical report of mortality.

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Klimkó has offered a classification as a working basis, which appears to have much merit.

GROUP I: Very serious cases with extremely sudden onset, rapid progress, and usually an unfavorable outcome. In these cases the autopsy shows widespread fat and pancreatic necrosis, colliquation abscess, hemorrhage.

GROUP II: Less serious cases with acute onset and a tendency to subside. In these, necropsy shows edema with less extensive fat necrosis; smaller sequestration, circumscribed abscess; and in later cases, pseudocysts.

GROUP III: Mild cases, with acute onset which ordinarily subsides. Autopsy reveals edema with fat necrosis.

CASE REPORTS

Three cases of acute pancreatic necrosis are presented, with two fatalities. The case which survived is believed to have had a mild type, the third group of Klimkó.

Case No. 1.—C. G. Male. Age, 46. A private, first-class, U. S. M. C. Patient was admitted on June 5, 1937, with the complaint that at 1015 he had been seized with a pain in the left chest "so terrible that he thought he would die." He had had several lesser attacks during the past 2 months, usually after smoking. The pain was not relieved by amyl nitrite and an opiate given for a supposed severe angina pectoris. The pulse was 92 regular. Heart was slightly enlarged by percussion to left and a systolic aortic murmur was noted. BP 150/110.

The abdomen was slightly distended and soft to palpitation, without masses or tenderness to palpation. An impression was gained at admission of (1) angina pectoris (2) aortitis (3) acute cardiac dilatation. At 1235 the patient suffered another attack of acute precordial pain, radiating down the left arm. This attack passed off in 10 minutes, after amyl nitrite had been given. At 1255, a similar attack occurred when the patient was described as cyanotic. The pulse became feeble and death occurred at 1300, 2 hours and 45 minutes after onset.

At autopsy, there was about 500 cubic centimeters of clear straw fluid in the peritoneal cavity. Liver, spleen, and kidneys appeared normal.

On opening the omental bursa, the whole pancreas was in a friable hemorrhagic state, the tail appearing as a jelly-like blood clot. There was very slight fat necrosis adjacent to the pancreas. The pancreatic tissue could be easily lifted away from the ducts, exposing the duct system, throughout.

The heart appeared broadened, and weighed 450 grams. The pericardium contained 200 cubic centimeters of bloody pericardial fluid. The visceral pericardium and myocardium showed evidence of old infarction in two areas of sclerosis toward the apex, with thinning of the myocardium beneath. The coronaries were tortuous, showed slight calcification, were patent throughout the larger branches.

Case No. 2.—Male. Age 36. A taxi-driver, F. N. R. Admitted February 20, 1937 complaining of a pain in the abdomen of 2 days duration which had lately become severe. The pain was located just above the umbilicus. Patient vomited 10 times the day prior to admission, without hematemesis. He denied recent alcoholic excess, but was a known alcoholic (previous admissions) and was patently inebriated, with blood alcohol of 1.5 milligrams per cubic centimeter

A previous similar attack had resulted in hospitalization in February 1937, which subsided, and another 6 months prior to that (left hospital in 2 days against medical advice). No symptoms between attacks. On admission, the patient was extremely nervous, giving impression of mild psychosis probably alcoholic. Pulse 100; temperature 97°; respiration 24; BP 156/98.

The abdomen was distended and there was marked tenderness over a small area just above the umbilicus with upper abdominal rigidity. Pressure elsewhere caused pain in the epigastrium.

0230, WBC (admission) 7,600.

0700, no change.

0930, WBC 13,200 with marked left shift in hemogram. Blood sugar 130 milligrams; chlorides 412; CO_2 68 percent. X-ray showed no pneumoperitoneum. Urinalysis showed, Sp. gr., 1.030; 50 milligrams of albumin; glycosuria of 2.5 percent; occult blood; several coarse and fine granular casts, with a few red cells. An X-ray of chest was negative.

1400 WBC 13,250 with same differential.

1900, WBC 17,900 with 98 percent polymorphonuclears.

The blood serum amylase (Todd) was 20 units.

A diagnosis of acute pancreatitis was made and patient prepared for operation with an intravenous of 1,000 cubic centimeters of 5 percent glucose-saline.

At laparotomy 100 cubic centimeters of brownish fluid was present in the right upper abdomen. No fat necrosis noted. The gallbladder, gall ducts appeared normal, without stones. The pancreas was enlarged 2–3 times normal and felt hard. Exploration through the gastrocolic omentum showed the pancreas of a beefy red color throughout its substance. Tamponade was done through the gastrocolic omentum and one drain brought to Morrison's fossa, through a right stab wound.

The patient made a good recovery from operation and the drainage of serosanguinous fluid from abdomen was considerable. He exhibited psychosis continuously, requiring sedatives.

The man became cyanotic and died on July 13, 1937, 5 days after onset, 3 days after operation. Autopsy showed no obstruction of the biliary system. The pancreas appeared as described at operation. On sectioning the pancreas, drops of pus could be expressed. Slight fat necrosis was now present. Microscopic examination showed extensive necrosis throughout the pancreas, less in the head than in the body and tail.

Case No. 3.—F. S. Male. Age 48. CPhM (Ret). Admitted on May 19, 1937, complaining that on the morning prior to admission he noted a "sinking feeling" in the pit of the stomach which lasted all day. The sensation was not painful and there was no nausea.

At 2100 on the evening prior to admission, a severe pain developed in the upper abdomen. He then vomited three times and the pain became agonizing. No previous similar attacks. Temperature 98°, pulse 104, respiration 20.

Examination showed desperately ill male. BP 130/78.

There was generalized tenderness over the whole abdomen, most marked over the epigastrium. It was noted that no real rigidity was present.

Operation was done immediately. No free fluid was present in the greater peritoneal cavity. The gallbladder was slightly larger than normal, very tense, and could not be emptied. The pancreas, especially the body, showed marked edema and there was subserous edema and bile discoloration about the duodenum. On opening the gallbladder several stones from ½ to 1 centimeter in diameter were found in normal bile. Cholecystostomy was done. Convalescence was complicated by a wound infection and by disruption of the right rectus incision on May 29, 1937, 10 days after operation; a pneumonitis of the right lower lobe, and

on June 21, 1937, a laparotomy was done for intestinal obstruction from adhesions. A jejunostomy was done at this time. On July 31, 1937, the jejunostomy tube was removed and patient has now completely recovered. A large ventral hernia is now present. No abnormality of blood sugar tolerance is present.

CONCLUSIONS

1. The syndrome of acute pancreatic necrosis is of especial interest, from its cataclysmic picture, and very considerable mortality.
2. The causative factors are not clear; the symptomatology and morbid anatomy are variable; and the therapy is disappointing at best.

DIAGNOSTIC ERRORS IN DISEASES OF THE COLON

WITH ILLUSTRATIVE CASE REPORTS

By Lieutenant (Junior Grade) JOHN BURKE, Medical Corps, United States Naval Reserve

An accurate and detailed history, a careful physical examination including sigmoidoscopy, proper laboratory studies, and above all, modern roentgen technique combine to make possible an accurate preoperative diagnosis in the majority of lesions of the colon. Fortunately there are few diagnostic emergencies in the natural history of colonic disease in which the time element is so important that these aids cannot be utilized.

Complete obstruction of the colon is as a rule slow in onset, and the time required for a carefully administered barium enema does not contribute materially to the operative risk. A flat plate for the determination of the location of gaseous distention can always be made in any case where operative intervention is feasible. In fact, the necessary delay for these elementary roentgen ray studies can be utilized for the patient's benefit. The treatment of dehydration and shock during this period increases the possibility of successful operative therapy.

There exist numerous lesions which are not susceptible to diagnosis by the above methods, and others whose symptomatology does not suggest colonic disease, and whose true nature is revealed at operation. In retrospect, perhaps most of these could have been correctly diagnosed. In practice, few of them are.

It would be futile to attempt to enumerate all of the lesions which might fall in this category. There are a few, however, which occur not infrequently, and which I have encountered and failed to diagnose in the past few years. It is possible that illustrative case reports may enable others to make correct preoperative diagnoses.

NONSPECIFIC INFECTIVE GRANULOMA

This lesion is not particularly common in comparison with tuberculosis, diverticulosis, or carcinoma of the colon, but it does occur

frequently enough to constitute a diagnostic problem. It occurs, as a rule, during the active period of life and both sexes appear to be equally affected. The etiology is uncertain. Foreign bodies within and without the colon, abdominal trauma, and infected mesenteric lymphnodes are thought to be the most common etiologic factors.

Mock,[1] 1931, gave a most comprehensive résumé of this subject. It is difficult to make the diagnosis from the history alone. The presence of a tumor is a more or less constant finding but malignancy and tuberculosis must be ruled out before nonspecific granuloma can be considered. X-ray examination may reveal an irregular filling defect within the lumen of the colon but this is not constant. Bargen and Larson [2] state that exploration may be necessary to establish the correct diagnosis. Even at operation the lesion may be confused with malignancy.

Case report (Granuloma of the Transverse Colon).—A female, age 39, was admitted with the complaint of a draining sinus from an operative wound. Her past history is rather interesting. About 20 years ago a thyroidectomy was performed at another hospital. While she was still in the hospital she developed an abscess in the pelvis. She was operated upon and a left salpingo-oophorectomy was performed. Her convalescence was apparently uneventful. Six months ago a hysterectomy and a right salpingo-oophorectomy was performed for functional uterine bleeding. The convalescence was very stormy and she was discharged from the hospital with a slight amount of drainage from the lower angle of the wound. The pathological diagnosis of the tissue removed was chronic salpingitis, follicular and corpus luteum cysts, hyperplastic endometritis.

She was next seen about 6 months following the operation when she stated that the wound had continued to drain intermittently small amounts of fluid. Whenever the drainage opening was closed, abdominal pain followed but disappeared with resumption of drainage. She had lost from 70 to 80 pounds in weight and suffered constipation for the past month and one-half. Relevant physical findings at this time were confined to the abdomen. "There is a scar from a supra-pubic incision. There is a mass underlying the scar, about 5 centimeters wide, apparently in the abdominal wound, as it may be encompassed by both hands. It is only slightly tender." An attempt was made to inject the fistulous tract with sodium iodide but this was unsuccessful. A flat X-ray showed an area of increased density in the region of the mass. My impression at the time was that the fistula was probably caused by a foreign body overlooked at the previous operation, and operation was advised.

Under spinal anesthesia an incision was made through the old scar down to the fistula opening which was encircled. Dissection was then carried on down to the fascia, and by combined blunt and sharp dissection the mass at the fistula opening was dissected free from the scar tissue to the left and from the edge of the right rectus muscle. At this point the peritoneum was opened below the mass. The fistulous mass was then dissected free on both sides until the peritoneal opening was large enough to admit one hand. On palpation it was found that the mass was attached firmly to the abdominal wall and extended upward to about the level of

[1] Mock, H. E.: Infective Granuloma, Nonspecific Chronic Tumorlike Productive Inflammation of the Gastrointestinal Tract. Surg:, Gyn. and Obstet., 52: 672–689, 1931.

[2] Bargen, J. A., and Larson, L. M.: Difficulties in Diagnosing Certain Lesions of the Right Side of the Colon. Med. Clin. of N. Amer., 15: 185–193, 1931.

the umbilicus. The entire mass was then dissected free, which necessitated prolonging the incision upward about 1 inch. It was then seen that the mass was attached to the anterior surface of the transverse colon and its appearance was definitely that of a carcinoma of the colon. After some deliberation it was decided to attempt a resection of the tumor-bearing area. The omentum was freed from its adhesions below. The colon was then isolated for 3 to 4 centimeters on either side of the mass and was resected between clamps. Continuity was reestablished by a side-to-side anastomosis. A cecostomy was then done and the wound was closed in layers. Postoperative diagnosis: Carcinoma of the Colon.

When the resected colon was opened it was seen that the mucosa was intact and that the mass appeared to originate from the outer layers of the colon. The tumor was studied in the State Institute for Malignant Diseases, where a diagnosis of chronic inflammation in tissue surrounding the colon was made. The convalescence was very stormy but the patient left the hospital at the end of 3 weeks with dry wounds. Some months later she developed a very marked ulcerative colitis and a fistula reappeared in her operative wound. About 1 year after this last operation she was reoperated at another hospital and what was said to be a jejunal fistula was excised. It reappeared, however, before her discharge from the hospital. It has not been possible to obtain further information concerning the patient.

Comment: Obviously, from the surgeon's viewpoint, she should never have been subjected to operation, as each operation was followed by numerous and disagreeable sequellae. In defense of the hysterectomy, she refused radiation therapy. Concerning the second operation, I was convinced that a forgotten sponge was responsible for the mass and the sinus tract. The etiology of the granuloma is still unknown.

VOLVULUS OF THE COLON

Volvulus of the small or large intestine is a not uncommon source for acute intestinal obstruction. In the large intestine the most frequent sites are the cecum and the sigmoid, the other areas being less frequently involved. The first requirement for a volvulus is abnormal mobility of the bowel. In this connection anatomical studies concerning the abnormal mobility of the cecum show an incidence which varies from 10 to 90 percent. Ten percent of all cases seen at autopsy have to some degree a common mesentery of the cecum and ileum, and in 1 percent there is a complete common mesentery.[3] Violent peristalsis following overeating or purgation may precipitate the occurrence of a volvulus. "The acute type is ushered in with great suddenness and severe paroxysmal pain, with some abatement of the symptoms between spasm." "Huge distention and meteorism which rapidly take place are constant and distinct features."[4] This lesion is found twice as frequently in men as in women and more than half of the cases occur in the third and fourth decades.[5] "Distinction in many acute abdominal conditions from acute volvulus is difficult."[4]

[3] Wandel, quoted by A. W. Fisher: Handbuch der praktischen Chirurgie, Kuttner, Garre and Lexer. Sixth edition. 3: 385, Ferdinand Enke, Stuttgart, 1929.

[4] Ranken, Bargen and Buie: The Colon, Rectum, and Anus, p. 110. W. B. Saunders, Philadelphia, 1932.

[5] Garre, C. and Naegeli: Th. Handbuch der praktischen Chirurgie, Kuttner, Garre and Lexer. Sixth edition. 3:652.

Case report.—A male, age 49, entered the hospital complaining of severe abdominal pain. The night before he had severe griping pain in the upper abdomen for which he took castor oil with little effect. There was severe and constant pain in the upper abdomen in the morning up to the time of admission. He vomited once. There had been occasional episodes resembling the present attack in the past, but these had been easily controlled by a cathartic. There was an indefinite history of indigestion, but its relation to meal time was uncertain. He denied venereal disease and did not work with lead. Upon examination he was acutely ill, sitting upright in bed, holding his abdomen with both hands and groaning. Essential findings were limited to his abdomen, which was retracted and boardlike in its upper half, and fairly rigid in the lower half. The epigastrium was extremely tender. Our impression at the time was ruptured peptic ulcer.

The patient was operated upon immediately under spinal anaesthesia. As this took effect a large sausage-shaped tumor arose in the right half of the abdomen, extending from the iliac crest to the rib border and filling half the epigastrium. An incision was made to the right of the midline, extending from 1 inch below the xiphoid to the level of the umbilicus. This was later extended above and below until it was about 8 inches long. Upon opening the peritoneum there was a deep red, distended mass comprising about a foot of ileum, the cecum and ascending colon including the hepatic flexure. This was twisted 180 degrees about its base, counterclockwise. The colon and ileum were firmly adherent and had a common mesentery. This mass was delivered out of the wound with difficulty and resection was decided upon. This was done at the noninvolved portions of the colon and ileum, and an end to side anastomosis was performed. A Witzel enterostomy was done in the proximal ileum and the abdominal wall closed in layers. There was considerable spill of intestinal contents during the anastomosis.

The convalescence was very stormy. Despite the ileostomy he developed a paralytic ileus which persisted for 5 days despite attempted duodenal drainage and the various means usually employed to produce peristalsis. On the fifth day eserine was suggested and its use was attended with dramatic and gratifying success. The further course was complicated by separation of the skin wound but the patient was able to leave the hospital 27 days after operation.

COMMENT: If this man's history had been properly evaluated it is possible that the correct diagnosis might have been made. As I see it now, the previous attacks of pain were caused by a twisting of the adherent cecum and ileum on their common mesentery. Catharsis or perhaps a change in posture allowed the loop to untwist. This last time the weight of the distended bowel was so great that untwisting was impossible. Nearly 24 hours of partial strangulation had so reduced the vitality of the bowel that despite hot packs it showed no signs of recovery. The ballooning out of the loop through the anaesthetized abdominal wall was most remarkable, following as it did the upward progress of the spinal anaesthesia. We were aware that this was a strange occurrence in the natural history of a ruptured peptic ulcer but we were entirely unprepared for the denouement.

PHLEGMON OF THE CECUM

Phlegmon of the gastrointestinal tract is seldom seen. There have been about 450 cases reported. The incidence of phlegmon apparently decreases in proportion to the distance from the stomach to the rectum. The lesion has the same characteristics in the intestinal tract as it does elsewhere throughout the body. The submucosa is

generally affected more seriously than the other layers. The streptococcus has been frequently found in the lesion but its portal of entry is quite uncertain. The diagnosis is scarcely ever made before operation and in many cases is made only by the pathologist. The symptomatology is, as a rule, that of the acute lower intestinal lesion with pain and fever as predominant characteristics. A tumor is frequently felt and one gains the impression that one is dealing with an inflammatory lesion of the large intestine. The diagnosis might be made more frequently if the possibility of this lesion is kept in mind. I have recently reviewed this subject in an article in the Archives of Surgery [6] and I have reported the following case in considerable detail, together with an extensive bibliography:

Case report.—A female, age 18, 4 days before admission began to have pain around the umbilicus and in the right lower abdomen. The pain gradually increased in severity but was somewhat alleviated by walking about. There was no nausea or vomiting. Administration of a cathartic, the day before hospitalization, resulted in many loose bowel movements the following day. On admission to the Buffalo City Hospital her temperature was 100° F., with a pulse rate of 84. The patient was a well-developed, well-nourished white female, not acutely ill. Pathological findings were limited to the abdomen which was negative for distention or spasm but had marked tenderness over the right lower quadrant with some tenderness on palpation of the right fornix of the vagina. Occasional red blood cells were in the urine. She had a leucocytosis of 13,300 with 70 percent polymorphonuclear leucocytes. A diagnosis of acute appendicitis was made.

A Battle incision was made under spinal anaesthesia. Upon opening the peritoneal cavity, there was no free fluid. The omentum presented into the wound. Palpation revealed what was thought to be a thickened retrocecal appendix. When the omentum was brushed away, a portion of it was intimately adherent to the cecum about an inch above the ileocecal valve. This was left in place and cut free from the remaining omentum after double ligature. It was then seen that the supposed retrocecal appendix was, in fact, a portion of the wall of the cecum. The cecum for about 3 inches was angry red in color, its serosa was rough and shaggy, and its walls were markedly swollen and edematous. The remainder of the colon was normal in appearance. There was definite demarcation between normal and pathological bowel. The appendix was uniformly fiery red and somewhat edematous. Its serosa was smooth and glistening and it was nowhere adherent. At the time of operation the author was not acquainted with the subject of cecal phlegmon, and in view of the fact that the involved bowel did not seem to be tuberculous or carcinomatous, and did seem to be an acute inflammatory process, ileocecal resection was not performed. An appendectomy was performed, the omentum was wrapped around the inflamed bowel, and the incision closed in layers without drainage. At the time the postoperative diagnosis was acute perityphlitis, acute periappendicitis. Convalescence was uneventful and on the eighth postoperative day the patient was discharged.

COMMENT: While we have no microscopic preparations of the wall of the colon, the clinical picture is identical with that presented by Hellstrom, Konjetzny, Demel, and others.

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[6] Burke, J. Archives of Surgery, in press.

THE TREATMENT OF LUNG ABSCESS

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In presenting this paper it is not our purpose to advocate one dogmatic type of treatment for pulmonary abscess, or to condemn any other type of treatment. We wish to give a brief general résumé of the modern concepts of treatment as obtained in a far from complete review of the literature, and present a case history showing the result of treatment.

There are, of course, but two general methods of treatment, the medical and the surgical. Likewise, lung abscesses of nontuberculous type are divided into two classes, those which are acute and those which are chronic. During recent years the conviction has grown that the acute abscesses should be treated medically and that surgery should be reserved for the chronic type, after a fair trial of conservative treatment. One is struck with the wide variety of treatments recommended which range from no treatment at all or only postural drainage, to drastic and extensive thoracic surgery. The variety of treatments advocated forces one to the conclusion that no one treatment is eminently successful.

The primary object of treatment is to establish constant and complete drainage of the abscess, while at the same time maintaining and conserving the patient's strength and resistance. That type of therapy which will best attain this objective in each individual patient is the treatment of choice.

From an etiological standpoint, it is concluded that 75 or 80 percent of the cases are the result of foci of infection in or about the head and neck, or operations upon these foci. In fact, one or two authors go so far as to say that all are either inhalation or embolic abscesses. However, a few have been attributed to bronchopneumonia, particularly the bronchopneumonia complicating influenza. Abscesses are practically never seen following a lobar pneumonia. Aspiration or inhalation abscesses are most apt to communicate with a bronchus. Distant infections, such as those which occur with infected abortion, phlebitis and abscesses in the abdomen and pelvis, are more likely to produce metastatic lung infections, and not single abscesses. Anesthesia can be a causative factor, although it is more probable that the pathology or condition which existed, and for the treatment of which the anesthetic was given, is the true cause. Abscessed teeth, infected tonsils and sinuses, and the treatment of them, hold the first place as the cause of lung abscesses in all reports.

The pathology of the lung abscess is not complicated. The lesion is, at first, a solid mass of inflammatory tissue, then as liquification occurs, a cavity filled with pus is formed. The walls are ragged and necrotic at the beginning, but as the abscess becomes more chronic

the walls become smoother due to fibrous tissue which is built around them. The wall of the acute abscess is a dense infiltration of polymorphonuclear leucocytes, and a greater or lesser number of mononuclear phagocytes. The odor, which is usually present, comes from necrotic tissue. When drainage is established, resulting in proper ventilation, the odor rapidly diminishes. Proper drainage and ventilation cause rapid collapse of the abscess walls, the circulation to the part improves and healing begins. Resolution of the inflammatory process occurs and in time the lung structure returns to normal. Little, if any, scar tissue or fibrosis results, but if the abscess has been in contact with the pleura, chronic hyperplastic pleurisy, with fixation to the chest wall, may persist.

The inhalation group of lung abscess is the largest, and this group usually follows operations on the mouth, nose, or throat, regardless of whether the anesthesia is local or general. The embolic group is small and the abscesses are more apt to be multiple, being metastatic. The large majority of lung abscesses lie well out in the lung parenchyma and touch the chest wall. A few lung abscesses, and these are rare indeed, lie close to the hilum or mediastinum.

As stated before, the treatment of lung abscess is varied and depends almost entirely upon the particular specialty of the physician in attendance. Specialists in diseases of the upper respiratory tract suggest that the best method of treatment is by means of drainage with the bronchoscope. The surgeons suggest that all lung abscesses should be treated surgically. Most of the pediatricians feel that postural drainage and medication are sufficient. A few internists have suggested the use of guaiacol and other drugs combined with postural drainage, and with, or without, pneumothorax. The radiologists recommend X-ray therapy. Each reports satisfaction with the special type of therapy as employed by himself.

Statistics of results obtained vary. Those cases treated by drainage with the bronchoscope show a mortality of 8 percent. The bronchoscopists are fair enough, however, in stating that by this treatment only half the cases show improvement. The mortality in the cases treated surgically varies from 2.7 to 52 percent, with an average mortality of 32 percent. The severest cases, acute and chronic, are those which have been treated surgically, hence the high mortality. The drastic surgical procedures include everything from thoracotomy, either in one or two stages, up through rib resection and thoracoplasty, to lobectomy. Any number of cases are reported in which bronchoscopy, postural drainage, and medication have failed, and in the late stages of the disease, after the abscess has become chronic, then, and only then, has the surgeon been called in consultation.

Those cases treated by medication alone, or in combination with postural drainage only, show a mortality rate of 20 percent. Authors

reporting the use of X-ray, with or without medication, and X-ray treatment, with or without pneumothorax, have had no fatal results. Simple postural drainage cases have shown no deaths. The mortality in cases reported as receiving artificial pneumothorax alone is 1 percent.

The distribution of the lesions as reported, show that the right lung is the one usually involved. Assuming that aspiration is the most common cause of lung abscess it is readily understood why the right lung is the more frequently involved. The proportion of right to left lung involvement is 2 to 1. In the literature reviewed only 12 cases of scattered or multiple lobe involvement were found.

In considering the fact that 25 percent is the value given to those cases which recover spontaneously, and taking into consideration the fact that only the simpler cases were treated by postural drainage and drugs, it would seem that probably these simpler cases would have recovered spontaneously without such treatment. Not infrequently an abscess heals spontaneously after rupture and drainage through a bronchus. In these cases the favorable result is, no doubt, due to the rapid collapse of the cavity, and its obliteration by the expansion of the surrounding lung tissue. Since collapse can result only when the cavity wall is nonrigid, it is evident that medical treatment must be instituted before fibrosis has produced a thick, rigid wall. This is especially true if treatment by artificial pneumothorax is to be used with the expectation of securing favorable result. That fibrosis and fibrotic adhesions can, and do, form in an amazingly short period of time will be demonstrated in our case report.

The objections to certain types of treatment made by authors who are not in sympathy with other than their own particular type of treatment, seems untenable. For example, the objection of a surgeon to the treatment of lung abscess by artificial pneumothorax is that in case of rupture of the abscess, the pleural cavity becomes infected and empyema results. However, statistics as given on the surgical cases show that with operation this same contamination of the pleural cavity occurs, and that about 12 percent of the post operative deaths occur from this very cause. Either the pleural cavity was not well enough walled off in the two stage thorocotomy operation, or the abscess ruptured into the pleural cavity after drainage was established. All authors who mention pneumothorax state that this type of therapy must be used in the early stages, if at all, and that in those cases in which hemorrhage occurs, it should at least be attempted.

Most authors fail to mention X–ray therapy. This can be due to the following reasons. In the first place, X–ray therapy is more or less new as applied to such conditions, and secondly, the action of X-rays upon infectious processes has not been thoroughly understood until recently. In those cases reported, 22 have been treated by X-ray only with no complications and no relapses occurring. The

improvement was rapid and started immediately after the first exposure. Progress in the healing of the abscesses was checked by films. Complete resolution occurred and little or no scar tissue formation resulted.

In the case which we are to report, the symptom which caused the patient to visit a physician was hemoptysis. This was not the first symptom noted, but was the first to cause alarm, and in this he was indeed fortunate in that it enabled treatment to be started very early in the course of his disease. Pneumothorax, X-ray therapy, absolute bed rest and supportive measures constituted the treatment. Disability was only 30 days total, and 14 days partial, although treatment was continued over a total period of 90 days.

Case Report

White, male, aged 41 years, married, salesman, first consulted one of us (RMM) on June 10, 1937, complaining of cough, bloody sputum, and, at times, bright red blood expectoration. Associated with these symptoms were fever, sweating, chills, generalized aching and extreme malaise. He stated that he had felt perfectly well until June 8. During the night of that date, which he spent in a neighboring city, he awoke with a chill, headache, and cough. He considered the symptoms as the onset of a "cold." He worked the following day, June 9, as usual, although he felt "sick all over." After finishing his day's work he drove home, a distance of 165 miles. During this trip home he began spitting up bright red blood, and did so many times during the 4 to 5 hours en route. During the night of June 9 he developed pain in the right upper chest, and called one of us (RMM) to his home on the morning of June 10.

Examination at that time revealed the following: Temperature 101° F., pulse 110, and respirations 18 per minute. He did not look as acutely ill as one would expect in an acute lobar pneumonia. The right upper chest anteriorly showed some impairment of resonance, and there were breath sounds suggesting a cavity. There were definite course rales at the level of the second rib anteriorly. None was heard posteriorly. A specimen of sputum was obtained and symptomatic treatment given pending the laboratory report. The report was as follows:

Specimen consists of serous fluid containing green purulent masses. No tubercle bacilli are seen. Gram stain shows numerous PMN's, streptococci, Gram positive dipilococci and Gram negative rods.

Guinea pig innoculation was made and subsequently reported as showing no evidence of tuberculosis. Close questioning relative to his family history was negative and there was no history of known contact with tuberculosis. Past medical history discloses no major operations, no illnesses and no injuries.

On June 11, 1937, an X-ray of the chest was obtained and an extensive shadow was revealed in the right upper lobe, with what appeared to be two cavities in the center of the area of increased density. While there was no distinctive odor to the breath the patient volunteered the information that the sputum was foul tasting and caused nausea.

Because of X-ray findings and the continued hemoptysis, artificial pneumothorax was immediately instituted on the morning of June 12, about 72 hours following his initial symptoms. The skin and parietal pleura were infiltrated with sufficient amount of 1 percent novocaine solution to produce local anesthesia and the needle was inserted into the right seventh interspace, posterior axillary line. There was no difficulty encountered in entering the pleural space. A marked negative initial pressure, which fluctuated with respiration from minus 4 to

minus 8, was changed to minus 1 minus 4 by the introduction of 400 cubic centimeters of cotton filtered atmospheric air—using the standard pneumothorax gravity bottles. On the second day, June 14, 500 cubic centimeters of air was introduced, and 650 cubic centimeters on June 16 and June 19, respectively. An X-ray film was then taken, showing insufficient collapse of the lung to have any appreciable effect upon the abscess cavities. Consequently larger amounts of air were given at more frequent intervals, e. g.:

	Cubic centimeters
June 21	1, 050
June 23	1, 000
June 25	1, 050
June 28	1, 050

Each of these refills brought the intrapleural pressure readings to plus one and minus one, or a slightly positive intrapleural pressure. An X-ray at this time showed satisfactory collapse of the cavities, and smaller refills of from 400 to 500 cubic centimeters were given at weekly intervals, and later at biweekly intervals.

During the time between June 12 and July 2 the patient was kept upon absolute bed rest, and the hemoptysis ceased within 36 hours following administration of the initial pneumothorax. His temperature reached a normal level on June 14 and remained below 100° F. throughout his treatment. The cough was less severe but the amount of sputum became considerably greater as collapse of the lung progressed. This, of course, was expected, indicating satisfactory collapse of the cavities. On July 7, X-ray therapy was given to the right upper chest anteriorly, and on July 9, another X-ray treatment was given over the right upper chest posteriorly.

During the course of treatment the blood serology was negative, the urine was negative, the hemoglobin showed 99 percent, the red blood cells numbered 4,900,000, the white blood cells numbered 12,150, and the differential count was normal. An intradermal tuberculin test was negative. Several additional sputum examinations were made with no appreciable change to be noted from the original report.

Convalescence was without incident. In all he received 18 pneumothorax refills, amounting from 400 to 1,050 cubic centimeters of air each. He was called from the city on business July 11, 1937, just 32 days after the onset of illness and received pneumothorax refills at biweekly intervals during July and August. On September 10, 1937 he returned home and film and fluoroscopic examinations on that date revealed very little collapse of the right lung. There was no sign of the original abscess at the right apex. Pneumothorax was abandoned and aside from occasional films of the chest as follow-up examinations he has received no treatment.

Incidentally, the patient gave a history to the effect that in March 1937, about 3 months prior to his illness, he had an abscessed tooth extracted from the right lower jaw under novocaine anesthesia. He had not associated this incident with his illness, as he had felt perfectly well in the interval. There is no other known incident which might have been an etiological factor.

RUPTURED CRUCIATE LIGAMENTS OF THE KNEE [1]

MODIFIED HEY GROVES RECONSTRUCTION OPERATION WITH CASE REPORTS

By Lieutenant E. M. WADE, Medical Corps, United States Navy

The cruciate ligaments are of considerable strength, situated in the middle of the knee joint, nearer to its posterior surface than to its

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anterior surface. They are called cruciate because they cross each other somewhat like the lines of the letter X, and have received the names anterior and posterior from the position of their attachments to the tibia. The anterior cruciate ligament is attached to the depression in front of the intercondyloid eminence of the tibia, being blended with the anterior extremity of the lateral meniscus; it passes upward, backward, and lateralward, and is fixed into the posterior aspect of the medial nonarticulating surface of the lateral condyle of the femur. It checks forward displacement of the tibia and hyperextension of the joint. The posterior cruciate ligament is stronger, but shorter and less oblique in its direction, than the anterior. It is attached to the posterior intercondyloid fossa of the tibia, and to the posterior extremity of the lateral semilunar fibrocartilage and passes upward, forward, and medialward, to be fixed into the anterior aspect of the lateral nonarticulating surface of the medial condyle of the femur.[2] The posterior cruciate ligament checks posterior displacement of the tibia when the knee is flexed.

Injury of the cruciate ligaments of the knee has become more frequent with the popularization of vigorous athletics, particularly football and skiing, together with the advent of high-speed automotive transportation, and the constantly expanding use of both civil and military aviation.

In a series of 241 cases of internal derangement of the knee joint, Dickson reports that rupture of the anterior cruciate ligament occurred 12 times, and in one instance both cruciate ligaments were injured.[3] That injury to a cruciate ligament seldom occurs without associated injury to other parts of the joint structure, especially the semilunar cartilages, the lateral ligaments, and the patella and its tendon, has been observed by many.

Injury to the anterior cruciate ligament is produced principally by overextension of the knee joint, the posterior ligament being frequently injured by direct trauma hitting from before, in the direction of the axis of the thigh.[4, 5] Extreme torsion may rupture both cruciate ligaments, and trauma with hyperabduction, adduction, and torsion may rupture all ligaments of the joint, permitting subluxation or dislocation.[6] It has been pointed out by Mitchell that in anterior dislocation of the knee, the anterior and commonly also the posterior cruciate ligaments are ruptured. In posterior dislocations of this joint, the posterior cruciate ligament is ruptured.[7]

[2] Lewis, Warren H.: Anatomy of the Human Body, by Henry Gray, 21st edition, p. 344, Lea and Febiger, Philadelphia, Pa.

[3] Dickson, Frank D.: Injuries of the Knee Joint. J. A. M. A., 110: 122, Jan. 8, 1938.

[4] Felsenreich, Fritz: Clinic of Injuries of the Cruciate Ligaments of the Knee. Arch. f. klin. Chir., 179: 375, Apr. 29, 1934.

[5] Felsenreich, Fritz: Injury of the Cruciate Ligaments. Wien. klin. Wchnsch., 48: 1058, Aug. 23, 1935.

[6] Strickler, Frank P.: A Satisfactory Method of Repairing Crucial Ligaments. Ann. Surg., 105: 912, June 1937.

[7] Mitchell, Joseph I.: Dislocation of the Knee. J. Bone and Joint Surg., 12: 640–646, July 1930.

The outstanding symptoms of cruciate ligament damage are instability with chronic or recurrent knee-joint effusion.[8] Objectively there is preternatural anterior-posterior mobility of the joint. This is regularly present immediately after the injury, but tends to disappear with the limitation of extension that commonly follows, due to joint effusion, periarticular hemorrhage and edema, incarceration of a fractured or dislocated semilunar cartilage, avulsion of the intercondylar eminence, or possibly incarceration of the torn cruciate ligament itself. Injury of the cruciate ligament is frequently overlooked in an injured joint, since voluntary muscular control of the knee is often acquired, and examination under general anesthesia may be necessary to demonstrate the typical findings. As a result of cruciate ligament injury, there may be abnormal lateral mobility, particularly if there is an associated injury of the lateral ligaments. The roentgen-ray diagnosis has been stated as presumptively positive in 13 percent of recent cases and in 53 percent of old cases. In the former the changes are avulsion fractures of the cortical layers in the region of the femoral and tibial sites of the cruciate ligament attachments, and fractures of the tibia, particularly the intercondyloid eminence. In the old cases there is often evidence of abnormal bone formation in the femoral and tibial fossae of the cruciate ligaments as a result of the looseness and abnormal mobility of the joint due to the primary injury. There may be evidence of an old fracture of the intercondylar eminence. Rational interpretation of the films is possible only with comparison with films of the opposite joint, and if practicable, views made early in the history of the case.[4]

Occasionally during arthrotomy for a recent internal derangement of the knee joint, there may be an occasion for an attempt to unite the ends of a ruptured cruciate ligament by suture. In general, however, the early treatment of cruciate ligament injury is conservative with immobilization in a cast or splint. Ordinarily, associated injuries to the external ligaments of the knee and disorders of the semilunar cartilages are treated by conservative surgery prior to reconstruction operations for ruptured or injured cruciate ligaments. It is believed by many that a complete rupture of a cruciate ligament never heals spontaneously, although following conservative treatment compensation for this disability is at times effected by voluntary contraction of the quadriceps femoris muscle.[9,10] This occurs particularly in young adults whose adaptability is great

[8] Gold, E.: Complete Plastic Substitution of the Anterior Crucial Ligament and Functional-Anatomic Restoration of the Same. Deutsche Ztschr. f. Chir., 213: 120, 1928.

[9] Campbell, Willis C.; Rupture of Crucial Ligaments. Dean Lewis' Practice of Surgery, 2: 160, W. F. Prior Co., Inc., Hagerstown, Md.

[10] Krida, Arthur: Reconstruction of the Anterior Crucial Ligament of the Knee Joint. S. Clin. North America, 10: 577, June 1930.

enough to permit the quadriceps femoris to take on what may be called a vicarious or compensatory function and maintain by its sheer efficiency the functional stability of the joint. In numerous instances there is no muscular compensation, and there is marked disability due to lack of stability of the knee, recurrent joint effusions, and tendency to subluxation.

In the chronic and grossly disabled case there are three possible forms of treatment: (1) Permanent brace wearing; (2) arthrodesis; (3) operative reconstruction.

The common present-day operative reconstructions of the anterior cruciate ligament are based on the technic of Hey Groves, published in 1917 and 1920.[11] This operation consisted in the transplantation of a pedicled graft of the iliotibial band, threaded through holes drilled in the lateral condyle of the femur and the head of the tibia in such a manner as to anatomically replace the anterior cruciate ligament. Operations for reconstruction of the posterior cruciate ligament have been described wherein the tendons of the gracilis and the semitendinosus are severed from their muscle attachments, and are brought forward through the inner part of the posterior ligament of the knee joint, and threaded through a hole drilled in the medial condyle of the femur and subsequently attached to the anterior aspect of the medial condyle of the femur.[9, 12] Free transplants of fascia, tendon, and the substitution of a ruptured cruciate ligament by silk, or an avulsed semilunar cartilage [13] have been reported, but the value of these procedures is questionable.

By a single operative reconstruction in vogue for at least the past 7 years in several United States naval hospitals, it has been possible to restore function of knee joints wherein either or both cruciate ligaments had been injured. A description of the operative technic with illustrative cases follows.

RECONSTRUCTION OF CRUCIATE LIGAMENTS

Under subarachnoid anesthesia, which may subsequently be supplemented by nitrous oxide-oxygen-ether inhalation, a large U-shaped incision is made in the front of the knee, the lower part of the incision being just below the tubercle of the tibia. The inner limb of the U runs along the line of the hamstring tendons, while the outer limb is about one fingerbreadth on the outer side of the patella.

The iliotibial band is defined by prolonging the outer limb of the incision upward. A strip of fascia, 8 inches long and 1.5 inches wide,

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[11] Hey Groves, E. W.: The Crucial Ligaments of the Knee Joint: Their Function, Rupture, and the Operative Treatment of the Same Brit. J. Surg., 7: 505–514, 1920.

[12] Tees, Frederick J.: Injuries of the Crucial Ligaments of the Knee Joint, with a New Method of Operating for the Repair of the Posterior Ligament. Canad. M. A. J., 26: 653–658, June 1932.

[13] Wittek, A.: Reconstructive Surgery of the Knee Joint. Wein. klin. Wchnschr., 50: 803, May 22, 1937.

is separated by two longitudinal and one transverse incision, the band retaining its original attachment to the head of the fibula.

The tuberosity of the tibia is chisled off, taking a generous chip of bone about three-fourths inch square and about one-half inch thick. The patella is turned upward after cutting through the capsule of the joint. The knee is flexed, the joint explored, and the ruptured ligament or ligaments demonstrated. All pathological semilunar cartilages, loose bodies, and at times ligamentary remnants which are encountered are removed.

A drill hole is made on the external condyle of the femur, the inner hole being placed in the center of the medial nonarticulating surface of the intercondylar notch. A second drill hole is made on the head of the tibia, just anterior to the intercondylar eminence, and with the external opening over the most prominent part of the medial condyle anteriorly.

The strip of fascia is pulled taut through the holes in the femur and tibia with the knee flexed at 90 degrees. The free end of the graft is passed upward over the inner condyle of the femur, and is fixed with interrupted chromic catgut sutures. The lower portion of the defect caused by the removal of the graft from the iliotibial band, and the incision in the joint capsule are closed with a few interrupted sutures. The tuberosity of the tibia is fixed to its original bed with interrupted chromic catgut sutures. The skin is closed.

Case Reports

Case 1.—Y. C. W., private, United States Marine Corps, age 17, admitted to the hospital on July 21, 1937.

History: Injury to the right knee in 1931, but no serious symptoms until 6 days ago when he fell on the drill field. This fall was followed by weakness and instability of the joint with a tendency to lock.

Examination: The only positive physical findings were abnormal anterior mobility of the proximal head of the right tibia, tenderness on medial side of right patella, and loud crepitations in joint during movement. The Kahn test was negative and urinanalysis revealed no abnormal finding. X-ray examination of the knee was reported negative.

Impression: (1) Rupture, right anterior cruciate ligament; (2) dislocation right internal semilunar cartilage.

Progress: The patient was treated conservatively, with subsidence of acute symptoms, but he continued to complain of instability and locking of the joint.

On August 31, 1937, arthrotomy of the right knee was performed under spinal anesthesia. The anterior crucial ligament was found ruptured, the internal semilunar cartilage was loose, and the prepatellar fat pad was hypertrophied. Excision of the internal semilunar cartilage and the hypertrophied fat pad was performed.

Patient recovered satisfactorily following this operation, but continued to complain of weakness and instability of the knee.

On October 28, 1937, under spinal anesthesia which was supplemented by nitrous oxide-oxygen-ether inhalations, the anterior cruciate ligament of the right knee was reconstructed according to the previously outlined technic.

The right knee-joint motions returned to normal with graduated exercises and physiotherapy, although he continued to complain of weakness and he was discharged from the United States Marine Corps on March 3, 1938, for physical disability.

Case 2.—G. R. T., fireman, third class, United States Navy, age 23, admitted to the hospital on April 13, 1937.

History: About 10 months previously he had slipped and twisted his right knee while taking a shower bath. Following this injury there was persistent soreness and the joint locked occasionally.

Examination: The only positive physical findings elicited were tenderness over internal border of right patella with some limitation of flexion of the knee. The Kahn test was negative and urinanalysis revealed no abnormal findings. X-ray examination of the knee was reported negative.

Impression: Dislocation, right internal semilunar cartilage.

Progress: On April 19, 1937, a small Jones' incision was made in the anteromedial aspect of the right knee, under spinal anesthesia. The appearance of the right femoral condyle was considered characteristic of osteochondritis dissecans, and six pieces of loose articular cartilage were encountered and removed.

Postoperative convalescence was slow, with tendency to recurrent joint effusion, but he was considered sufficiently improved on June 11, 1937, to be returned to duty.

Patient did not improve on duty, and symptoms of locking and soreness of joint recurred. He was returned to the hospital on September 2, 1937, at which time the physical findings were similar to those noted at the time of the original admission. X-ray examination of the joint was again reported negative. It was felt that the symptoms were due to the previously diagnosed osteochondritis dissecans.

On September 21, 1937, the knee joint was explored under spinal anesthesia, and the anterior cruciate ligament was found to be ruptured. A pedicled strip of the iliotibial band was passed through holes drilled in the external condyle of the femur and the head of the tibia and secured as previously outlined.

Early in the postoperative period there was inability to fully flex the knee, although function gradually returned with active motion and physiotherapy. He was returned to duty on January 14, 1938, improved.

Case 3.—E. H. B., yeoman, third class, United States Navy, age 26, admitted to the hospital on February 16, 1936.

History: Injured on day of admission when the motorcycle on which he was riding crashed into a heavy post.

Examination: The positive physical findings noted on admission were tenderness in lumbar area, principally over lateral muscle groups, and swelling, deformity, and loss of function, left knee. The Kahn test was negative, and urinanalysis revealed no abnormality other than a transitory trace of albumin. X-ray examination revealed a comminuted T-shaped intercondylar fracture of the proximal head of the left tibia and a comminuted fracture of the left second transverse process of the second lumbar vertebra.

Impression: (1) Fracture, left tibia involving knee joint; (2) fracture, simple, transverse process, second lumbar vertebra.

Progress: The left leg was put up in Russel's traction, followed by a posterior molded splint, and later on April 22, 1936, he was allowed up with a Thomas caliper brace. There was preternatural anterior mobility of the knee joint, but he was free from symptoms when he wore an elastic bandage. His disability was considered to be a ruptured anterior cruciate ligament of the left knee and he was discharged from the Naval Service on November 27, 1936, because of physical disability.

On August 28, 1937, he was involved in an automobile accident, and was readmitted to the hospital as a pensioner. Physical examination revealed preternatural anterior mobility of left knee.

The left knee joint was explored under spinal anethesia and the anterior cruciate ligament was found to be torn with only a small shred remaining. The anterior cruciate ligament was reconstructed, using a pedicled fascia graft as previously described.

The result of the cruciate ligament reconstruction operation was good.

Case 4.—F. A. M., age 20, electrician's mate, third class, United States Navy, admitted to this hospital on February 24, 1938.

History: On January 5, 1938, while investigating a casualty in a turret powder hoist, the motor was inadvertently started, and his right knee was caught between the flanges of the hoist and the powder table. He was treated aboard the U. S. S. *Relief*, with rest and physiotherapy, followed by immobilization of the leg in a cast, until transferred to this hospital.

Examination: Upon admission there were no abnormal physical findings except a circular plaster-of-paris cast encased the right leg from groin to ankle, holding the knee in a position of extension. The Kahn test was negative, and urinanalysis revealed no abnormal findings. X-ray examination of the right knee was unsatisfactory because of the cast.

Clinical Impression: Deferred.

Progress: The cast was removed on March 3, 1938, and X-ray examination of the right knee was reported negative except for a chip fracture involving the lateral aspect of the lateral condyle of the right femur, without displacement of the fragment. Physiotherapy followed by active motion and weight bearing was instituted. Function of the right knee improved gradually, permitting 90-degree flexion and complete extension, but with an occasional sudden locking in a position of incomplete extension, which was relieved by flexion and manipulation of the joint. As mobility of the right knee improved, a marked preternatural anterior mobility of the joint became apparent, and there was a marked sense of insecurity while walking.

On March 24, 1938, the knee joint was explored with the belief that the patient was suffering from a dislocated internal semilunar cartilage and a ruptured anterior cruciate ligament. The semilunar cartilage was found to be normal, but the anterior cruciate ligament was ruptured. The exploratory incision was lengthened and the anterior cruciate ligament was reconstructed according to the previously outlined technic. Examination of the knee before patient left the operating-room table revealed no abnormal anterior-posterior mobility of the joint.

The final results of this case cannot be evaluated at this time, since the patient was operated upon just prior to the preparation of this report.

SUMMARY

The operative procedure employed in these four cases differs from the original Hey Groves' technic in that the distal end of the femur and proximal head of the tibia are drilled in such a manner that the newly constructed cruciate ligament does not follow the oblique course of the normal anterior cruciate ligament, but passes from above downward in almost a vertical plane. This method has been found to satisfactorily stabilize the knee joint following injury to either or both cruciate ligaments.

INTRANASAL PROCAINE ANESTHESIA

By Lieutenant Commander BRUCE V. LEAMER, Medical Corps, United States Navy

In 1932, having had two near fatalities while using 10 percent cocaine as an intranasal topical anesthetic, we decided to use procaine solution as a substitute.

It is a generally accepted theory that procaine is poorly absorbed through the mucous membranes. We believe that the following report will show that it is absorbed, and that it is a valuable substitute for cocaine.

Novocaine hydrochloride (procaine) was discovered by Einhorn in 1900. Braun tried it out on a large series of cases and it is largely due to his efforts that it has become so widely used. He found that the addition of adrenalin to the drug not only diminished the rapidity of its absorption but also increased its potency. After more than 30 years of use it has proven to be the safest of all local anesthetics. Referring to the requirements of a local anesthetic, as outlined by Braun,[1] novocaine hydrochloride meets these requirements. It is less toxic than cocaine in proportion to its local anesthetic value. It has been shown that it causes no irritation or tissue injury. It is absorbed from the tissues without hyperemia, inflammation, or necrosis. It is soluble in water; solutions are stable and possible of sterilization by boiling. It is compatible with the vaso-constrictor principle of the adrenal gland. It is slowly absorbed through the mucous membranes. Injected locally, it exerts a pronounced, prompt anesthetic action. It is not habit forming. Hooper and Becker [2] show that whereas approximately 10 milligrams of either butyn or cocaine per kilo of body weight was fatal, more than 45 milligrams per kilo of body weight of novocaine was tolerated.

The investigating committee of the Therapeutic Research Committee of the Council on Pharmacy and Chemistry, in their summary of deaths from local anesthesia, in 1924,[3] report 43 deaths and of this total 26 were caused by cocaine or the combined use of cocaine and novocaine. Novocaine, which was found to be used more frequently than any other anesthetic, was responsible for but one death.

There is little mention in the literature prior to 1933 of the use of procaine as a topical or surface anesthesia. Labat [4] and DeTakats [5] note in their writings that if used in sufficient concentration, it has an anesthetic effect on the mucous membranes.

The following procedure was used: A 20 percent solution of novocaine hydrochloride was made up and to this was added an equal amount of 1:1000 adrenalin, making a 10 percent solution of novocaine in adrenalin. One hour prior to the

[1] Braun (Local Anaesthesia). Lewis Practice of Surgery, Vol. I.
[2] Hooper and Becker. American Journal of Medical Sciences, March 24, 1924.
[3] Report of Therapeutic Research Committee of the Council on Pharmacy and Chemistry, 1924.
[4] Labat. Regional Anaesthesia, 1923.
[5] DeTakats. Local Anaesthesia, 1923.

operation, the patient was given 5 grains of barbital by mouth. At operation, strips of long fiber cotton were saturated in the solution. After the excess fluid was expressed, these strips were inserted into the nose, taking care that one strip was placed at the posterior end of the middle turbinate in as close proximity to the sphenopalatine ganglion as possible and another strip in the superior meatus of the nasal cavity. Then enough strips were inserted to completely plaster the septum. Following the insertion of the cotton strips, 1 percent novocaine was injected at the mucocutaneous junction, into the floor and along the septum. Then after waiting 15 minutes, the strips were removed and the operation carried out.

These patients had very little pain, but were somewhat uncomfortable. After considerable experimental work, using 15 percent to 20 percent solutions of novocaine with varying amounts of adrenalin, it was found that 3 parts of 20 percent novocaine solution to 1 part of a 1:1000 solution of adrenalin gave the best results. Approximately 60 cases were operated on using this anesthetic. All of them were free from pain during the operation.

The procedure as already described is now used, except that a full 20 minutes is allowed for the anesthetic to take effect rather than only 15 minutes as was tried at first. More than 200 cases of intranasal surgery have been operated upon in the past 5 years, using this anesthetic. All of them have been free of pain and other discomforts and there has been no evidence of any toxic manifestation.

In summarizing, the toxicity and anesthetic value of cocaine and novocaine have been compared. A method for the use of novocaine as a topical anesthetic has been outlined which has proven very satisfactory and has relieved the writer of the anxiety attendant on the use of cocaine.

CORNEAL TRANSPLANTATION FROM THE STANDPOINT OF FINAL RESULTS

By Commander Edwin C. Ebert, Medical Corps, United States Navy, and Lieutenant Robert C. Boyden, Medical Corps, United States Navy

Surgical operations for the transplantation of corneal grafts have been performed with various degrees of clinical success for a period of almost half a century. Most glowing results have been reported by the public press. The unfortunate part of the publicity is that it reports only the immediate, and usually gratifying results, and fails to investigate and report with equal emphasis the final results. This incomplete reporting may engender false hopes in those in need of new corneas. The surgeons' reports are usually not so glowing, for usually corneal injuries are so extensive and complicated by iris adhesions, that conditions are not favorable for transplant. Rarely does a favorable case present itself for corneal graft coincidentally with another case having a healthy cornea available for the graft.

Injuries of the eye due to the advent of the machine age and rapid motorization, keratoplastic repairs and corneal transplantations are becoming an increasing problem in the United States Naval Medical

Service. Of the four cases here, three were done in Haiti (by E. C. E.) and the fourth at the naval hospital, San Diego, Calif., by both writers. The writers consider their results of operations on four cases over a period of 12 years worthy of report.

Corneal transplantations are done for two principal reasons: 1. Removal of central leucomas of the cornea to improve vision. 2. Support of weakened cornea due to ulcerations and lacerations. Each has its place depending upon the condition of the cornea requiring the transplant. The writers with their four cases, and very limited experience find that the illustrated ribbon transplant is the most effective. (See figs. 1 and 2.) In all transplants the leaving of a thin veil of Descemet's membrane for a shield is very essential for a successful transplant.

The different technics which have found favor differ mainly in the size and shape of the corneal graft used. Total keratoplasty is defined as a transplant of the entire cornea with or without Descemet's membrane. Partial keratoplasty, of course, denotes the transfer of a portion only of the cornea. This section may be square, rectangular, round, or transcorneal as noted by drawing. There has been considerable discussion as to whether the graft remains permanently, or is eventually absorbed and replaced by ingrowth of corneal tissue from the host. Suffice it to say that in either case cicatricial and leukomatous changes frequently supervene and eventually reduce the area grafted to its initial state of opacity. It is this final result which the newspapers do not report.

From the standpoint of nutrition, the entire cornea, with its fringe of conjunctiva, would seem to offer the most favorable chance of success. However, this superior blood supply may act to defeat its purpose as it has been observed that new capillaries invade the graft between itself and its bed before complete coherence has been accomplished and produce, circumferentially at least, the leukomatous changes mentioned previously.

Corneal transplants present the following sequellae as noted by our observations in the four cases:

1. During the first 48 hours the transplant remains clear and transparent.
2. After this period the transplant becomes edematous and misty.
3. After 10 days vascularization of transplant border occurs.
4. Later and up to 6 months reorganization or cicatricial changes take place along the border.

In conclusion we wish to state that corneal transplant should be attempted in all favorable cases with hopes that a certain amount of visual perception may be regained.

It is our impression that no prognosis should be ventured until at least 6 months after the operations.

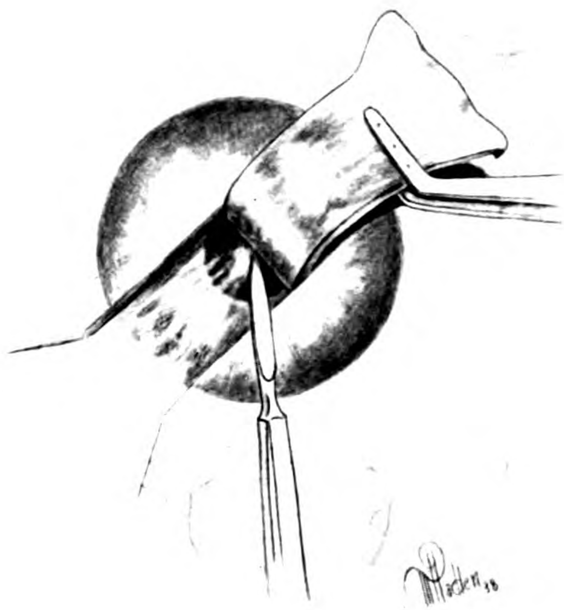

FIGURE 1.

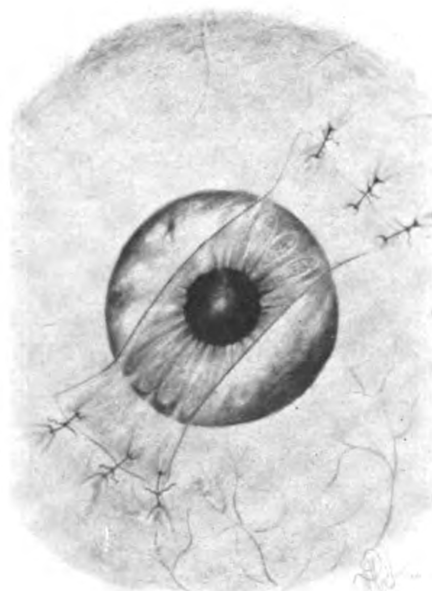

FIGURE 2.

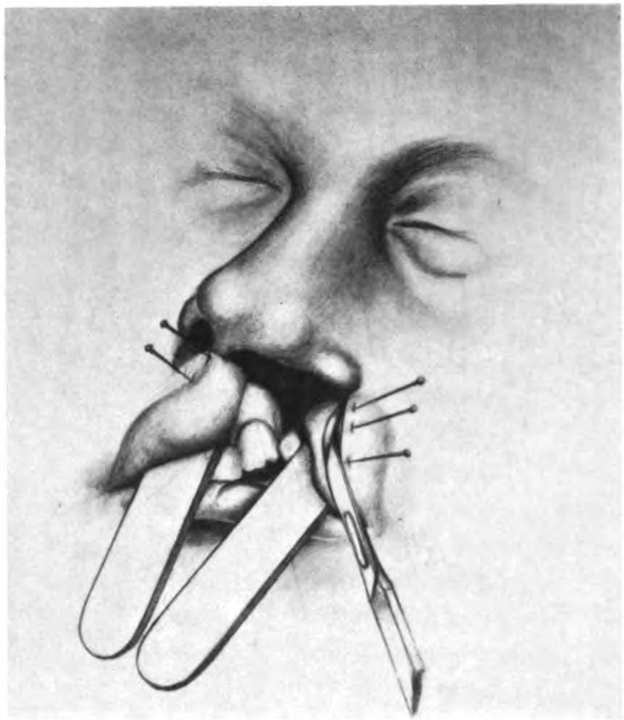

FIGURE 3.

FIGURE 4.

AN IMPROVED METHOD OF LIP FIXATION

FOR HARELIP AND OTHER DEFECTS

By Commander EDWIN O. EBERT, Medical Corps, United States Navy, and Lieutenant ROBERT O. BOYDEN, Medical Corps, United States Navy

Satisfactory fixation of the lip for the operative repair of injury and the treatment of congenital deformity is a troublesome and difficult task to perform without traumatizing the tissue by clamps and forceps. This is due to the redundant nature of the lip, which causes it to roll under the finger. Due to this difficulty in immobilization, the operator finds that accurate incision lines, which are of such vital importance in reparative surgery of the lip, are a vexing problem.

During tours of duty in the West Indies and the Orient the writers observed the relatively high incidence of congenital lip deformities among the natives of those countries compared to that among Occidentals. Whether this prevalence is due to dietary, hereditary, or hygienic factors is not within the scope of this short article. It did, however, provide a relatively large number of cases which were treated by the technic described in the following paragraph.

As shown in figure 3 fixation is accomplished by impaling the lip on an ordinary wooden tongue depressor with heavy common banker's pins. Closure lines having been marked out, the incision is made along these lines. The authors prefer to employ a new sterile razor blade held in a curved hemostat.

At this point another advantage of this method becomes apparent; approximation of the lip segments is rendered more facile and exact by manipulation of the free ends of the tongue depressors. The edges are brought into place and held there by an assistant while the operator places the sutures unhurriedly. Figure 4 shows the sutures in place.

Cosmetic and functional results in the cases operated, using this procedure, were exceptionally satisfactory and it is felt that the fixation described was responsible in a large measure for the success obtained.

FACIAL INJURIES

TREATMENT OF SPECIAL INTEREST TO THE DENTAL SURGEON

By Lieutenant MERRITTE M. MAXWELL (Dental Corps), United States Navy

In these days of high speed transportation with the utilization of automobile, motorcycle, and aeroplane by naval personnel, head injuries of various types and degrees of severity are often encountered. Frequently the jaws, as well as other facial bones, are disrupted in their continuity. It is not uncommon to find, as an associated complication, the more serious conditions of skull fractures and severe concussion.

Quite often the value of the prompt reduction and treatment of fractures about the face is overlooked. To quote P. J. Aufderheide, "We have all seen many patients lie around hospitals from 1 week to 2 months without attention to fractures with which we are dealing."[1] He further stresses the importance of calling to the attention of hospital medical staffs the necessity of early treatment.

The blood supply of the bones about the face is abundant and regenerative processes, in the absence of infection, are early initiated. Fibrous union occurs within a short time and should these bones unite in malposition a permanent facial deformity may result.

Malunion of the bones of the upper face is a serious matter and presents a deformity difficult of correction. Whereas, in the case of the malunited mandible, refracture with reestablishment of normal relation of the parts can be much more easily accomplished.

In cases of severe head injury the life of the patient is, obviously, the matter of first importance, and if he should be suffering from concussion, shock or skull fracture, appropriate treatment must be instituted. However, after consultation with the medical officer in charge of the case, and as soon as the condition of the patient warrants, there should be no delay in coaptating the variously fractured facial bones. This procedure has its chief value in that it not only makes the patient more comfortable, but also serves as a safeguard against complications and subsequent deformities.

Kazanjian states "Fractures should be immobilized as soon as possible, to hasten the healing process and above all, to prevent the spread of infection into the fractured area."[2] A large percentage of fractured jaw cases are compounded within the oral cavity, consequently prompt reduction will minimize the possibility of infection from the bacteria ever present in the mouth and will tend to circumvent a possible severe cellulitis or osteomyelitis.

Fractures of the maxillae and adjacent facial bones are quite often of the impacted type. With the bones contacting each other in this malrelation ready union will usually occur.

It may be well to sound a word of caution regarding emergency head bandages. In cases of the fractured mandible it has been noted that bandages are used which pass around the anterior surface of the chin, thus drawing the fractured parts into a retruded position. This results in an overriding of the fractured ends of the mandible; the tissues of the floor of the mouth together with the tongue are depressed toward the oral pharynx, thereby adding to the patient's discomfort by interfering with normal respiration.

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[1] Aufderheide, P. J. Treatment of Fractures of the Maxillae, Mandible, and Other Bones of the Face. J. A. D. A., 21: 950-961, June 1934.

[2] Kazanjian, V. H.: Traumatism of the Face and Jaws with Special Reference to Complications. J. A. D. A., July 1934.

Various types of head bandages are employed for stabilization of fractured jaws, the more commonly used ones being the Barton, the modified Barton, Gibson, and the four-tailed. Where there is displacement of the fractured parts, a head bandage cannot be relied upon to maintain reduction and if used at all it should be used only for temporary or emergency immobilization.

Ordinarily a simple bandage passing under the chin and over the vertex of the skull will provide a state of rest for the fractured parts and will suffice until more appropriate treatment can be rendered.

For the reduction and immobilization of fractured jaw cases, interdental wiring, splints, and arch bars, used alone or in combination with some type of headgear, are recommended. As a general rule it may be stated that the best appliance to use is the simplest one which will insure the desired end result.

In selecting the method to be employed for the reduction and immobilization of fractured jaws, the thought of chief concern is the restoration of normal function of the masticatory apparatus. To achieve this end a plan of treatment must be formulated whereby the patient's teeth may be brought into occlusion according to his specific norm.

It will be found that each case is an entity in itself and due consideration should be given to the following factors in the selection of an appliance:—

1. Selection of method which will bring about the desired end result.
2. Ease of application.
3. Facility with which subsequent adjustments may be made.
4. Adequacy in obtaining traction where such is necessary.
5. Once reduction is accomplished, the means to maintain immobility of the jaws with the teeth in normal centric occlusion.
6. Comfort of the patient.

(*a*) An appliance of the least intraoral bulk compatible with efficiency.

(*b*) Provision for proper oral hygiene by the patient.

Several methods may be equally suitable for establishing a successful restoration to normal. If this condition exists it would seem that the choice of the method to be employed should be the one with which the operator is the most familiar and which has given the best results in his hands.

With the majority of fractured mandible cases, I have found the hook method, to be described later, and the Oliver eyelet system as used by Ivy,[3] to be efficient. In the more complicated cases, arch bars, cast splints, or other devices may be utilized to best advantage.

[3] Ivy, R. H.: Surgical Treatment of Acquired Deformities of the Mouth and Jaws. Dental Cosmos, February 1927.

The eyelet method of wiring the teeth was suggested by Col. T. Oliver in 1910. Silverman and Eby in 1918 modified the usage of the eyelet by passing one of the wire ends through the eye before twisting the free ends together. Ivy cites an outstanding advantage of this method to be that in the event of a tie wire breaking it may be readily replaced without the necessity of changing the base wires. In cases of emergency, or for any other reason, when the mouth must be opened, the tie wires can be cut, leaving the base wires intact.

The outstanding advantages in favor of the eyelet system are its ease of application and convenience of subsequent adjustment. The certainty with which normal centric occlusion is established is appealing.

From the patient's standpoint, the eyelet wiring permits him to maintain a high degree of mouth hygiene due to its lack of intraoral bulk.

In lieu of the eyelet method, a hook appliance devised and used at this hospital appears to have some merit. It can be used in any case where the eyelet is indicated, with the additional advantage that either elastics or tie wires, as may be necessary, supply the intermaxillary binding.

The hook wires are easily formed from any of the various types of ligature wire used in jaw fracture work. I prefer stainless steel wire 0.014–0.008 inch. Wipla rustless steel ligature (0.008 inch) is very satisfactory as it makes a strong hook, although it is harder to work than some of the other types of wire which are more free from spring and temper.

To form the hook, a 6-inch length of wire is bent in the middle and thus doubled over on itself. The doubled end is grasped with a pair of small straight hemostatic forceps, about 2 mm from its extremity, and a tight twist is made by once rotating the hemostat figure 5 (C). Adjacent to this twist an eye is formed by the interposition of a straight explorer or steel probe between the two wires, succeeded by two tight twists as shown in figure 5 (D). The hook is then shaped from the doubled end of the wire with the aid of the straight hemostat figure 5 (E).

The hook wire is ligated to the teeth in the same manner as the eyelet wires of Oliver, except that the free end of the wire passing around the distal anchor tooth is brought forward to pass through the eye, above described. This will prevent the hook from being drawn into the interproximal embrasure when the final twisting of the wire ends is being accomplished, figure 6 (A and B).

In association with fractured maxillae, a fracture or fractures of the hard palate with the occasional loss of hard tissues in this area are sometimes encountered. As a result there is established a traumatic

opening into the nasal cavity or into one or both of the maxillary sinuses.

In regard to these and similar openings into adjacent cavities Ivy states:

Losses of substance of hard tissue of the upper jaw of any considerable extent are best replaced by intraoral artificial appliances attached to the teeth or held in place by suction. This rule applies to defects resulting from excision of the maxillae for neoplasm, large perforations of the palate due to syphilis, trauma, etc. However small syphilitic or traumatic openings can frequently be closed by mucoperiosteal flaps loosened from each side of the defect and carried over to meet each other. Whenever possible, surgical corrections is preferable to the use of artificial appliances.[3]

To assist in the primary union of the closely sutured flap, a prosthetic appliance covering the roof of the mouth has been demonstrated to be of value. This covering of the palatal vault prevents the patient's tongue from toying with the sutures, as well as minimizing interference with the healing processes during eating. Thus a more successful "take" of the mucoperiosteal flap is assured.

Intraoral perforations into the maxillary sinuses are somewhat similarly closed by the use of a flap taken so as to meet the requirements of the particular case being operated. The operation of Dunning has been found to be very efficient.

By this method a tongue-shaped flap is freed from the hard palate, its anterior end running well forward of the antral opening. This flap is turned across the opening and its end sutured beneath a previously loosened curtain of tissue on the cheek side.[4]

It has been suggested that small antral openings, if not complicated by antral infection, can occasionally be closed by the simple use of electro-cautery. With this conservative method there was no success. With 10 cases uncomplicated by infection and so treated not a single closure was obtained.

After the flap operation for closure of antral openings, a protection for the flap, in the nature of base plate material or heavy tinfoil, is recommended for the protection of the tissues during healing. In the event the patient is edentulous and using dentures, the upper denture admirably serves this protective purpose. However, a denture when so used should be relieved so as not to bring undue pressure on the palatine artery supplying the flap or the result will be a failure.

When infection and suppuration are present in the antrum, surgical intraoral closure is contraindicated. In cooperation with the rhinologist the infection must first be aborted. Infection obviously not only adds to the hazards of operation, but also with the welling up of pus in back of the flap sutures, closure becomes impossible.

[4] Dunning, H. S. Flap Operation. J. A. M. A., 25: 1391, 1920.

Traumatic injuries of the head quite often present fracture of the zygoma and zygomatic arch, in association with fractured maxillae and mandible.

A depressed malar fracture, if seen early, is not usually difficult to reduce. However, after the elapse of several weeks time, with fibrous union in malposition ensuing, reduction becomes much more difficult.

A number of methods have been advocated for elevating the depressed zygoma. The use of tenaculum forceps, the corkscrew, or a hook inserted into the bone with elastic traction to a facial bar, have all been used with varying degrees of success by different operators.

In hospital practice the Gillies operation for reduction seems to be commonly used. The technique involved here is to make a curved incision about 1½ inches long above and in front of the ear within the hair-line. The temporal fascia is incised and a flat, thin, but sturdy elevator, is passed downward and forward over the temporal muscle, to engage the internal surface of the malar bone. The bone is then manipulated into its normal position.

An operation of more interest to the dental surgeon is that of intraoral reduction. In this operation an incision is made in the buccal fold above the apices of the upper molar teeth on the side of the depressed malar. The tissues are retracted upwards, posterior to the malar eminence and a sturty hooked instrument is passed into the zygomatic fossa to engage the internal surface of the zygoma. By exerting pressure upward and outward the depressed bone can usually be manipulated into its correct anatomical position. Ordinarily no fixation is required.

Reduction can be checked by palpation along the infraorbital ridge, the zygomatic arch, and the frontal process, as well as by X-ray.

Intraoral reduction has the advantage of being simple to carry out, with the additional advantage that relatively unimportant structures are passed through in traversing the route indicated. Access to the internal surface of the malar is readily obtained by the intraoral method. A disadvantage exists in that a sterile field is difficult, if not impossible, to maintain.

In those cases where the malar requires fixation to retain its position, kangaroo tendon may be used to ligate the bone to the pyramidal process of the frontal bone.

Straith [5] uses a curved antrum trocar for the intraoral manipulation of the malar bone into position. An instrument for this purpose devised at this hospital has been found useful. It consists of a sturdy curved steel shaft (4½ inches long) supplied with a handle large enough so that a firm palm grasp can be secured. The extremity of the shaft (⅝ inch from the end) is so shaped that it can pass under the maxillary process of the malar bone so that the sharpened end bites

[5] Straith, C. L., and Straith, F. E.: Facial Bone Injuries. Dental Digest, October 1933.

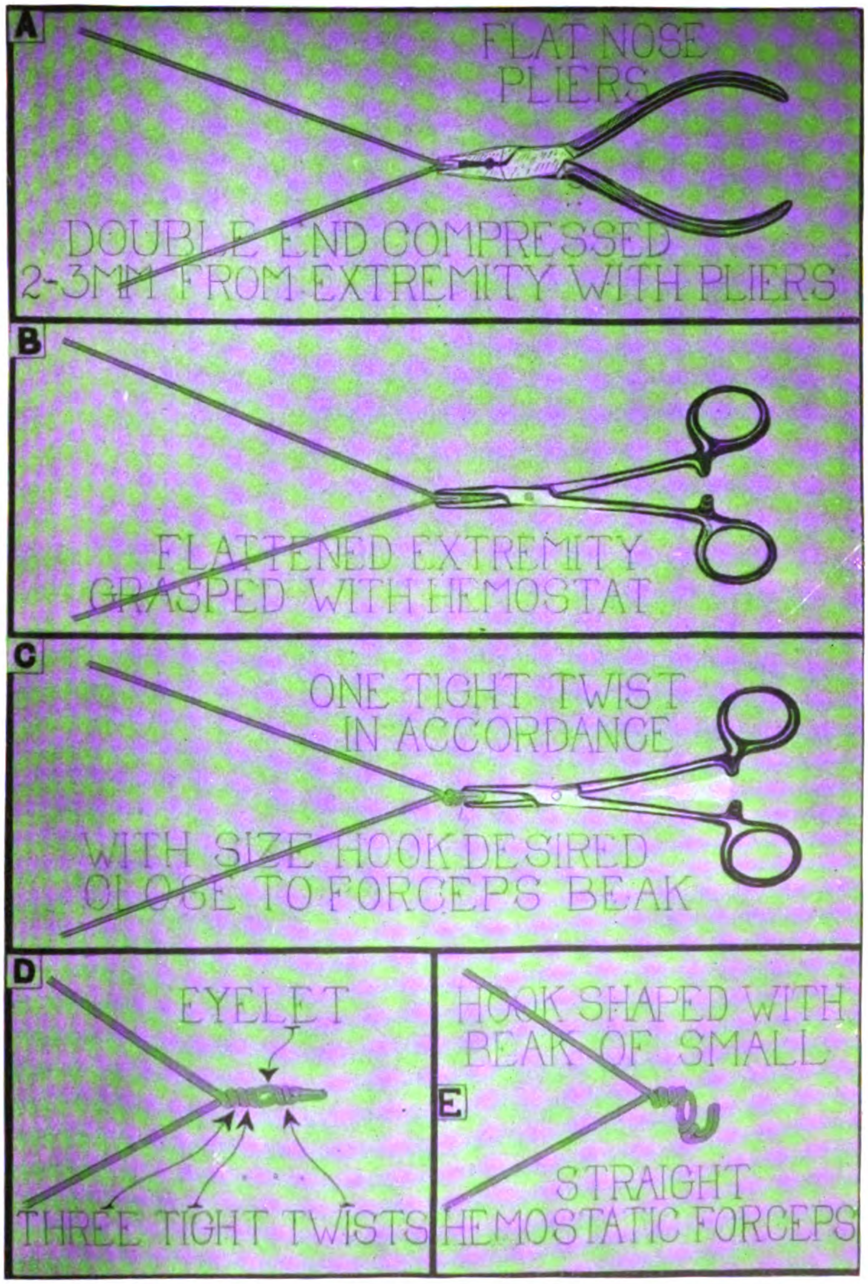
A
FLAT NOSE PLIERS
DOUBLE END COMPRESSED 2-3MM FROM EXTREMITY WITH PLIERS
B
FLATTENED EXTREMITY GRASPED WITH HEMOSTAT
C
ONE TIGHT TWIST IN ACCORDANCE
WITH SIZE HOOK DESIRED CLOSE TO FORCEPS BEAK
D
EYELET
THREE TIGHT TWISTS
E
HOOK SHAPED WITH BEAK OF SMALL
STRAIGHT HEMOSTATIC FORCEPS

FIGURE 5.

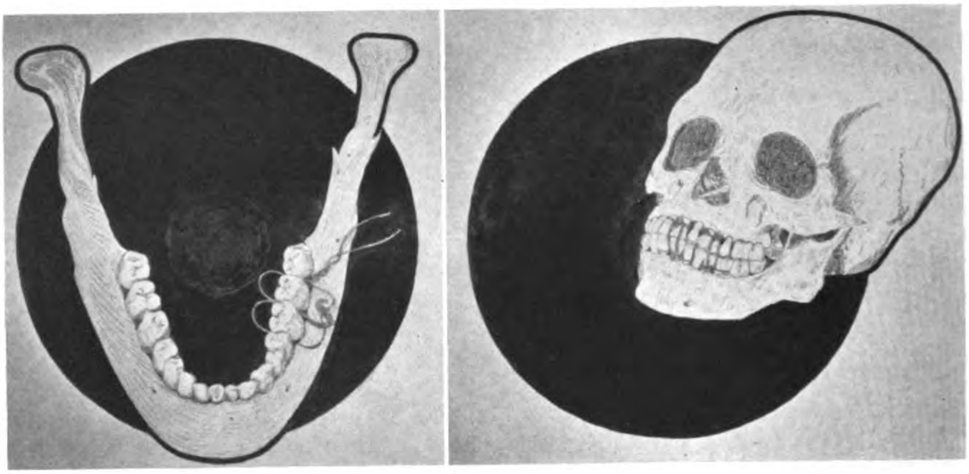

FIGURE 6.

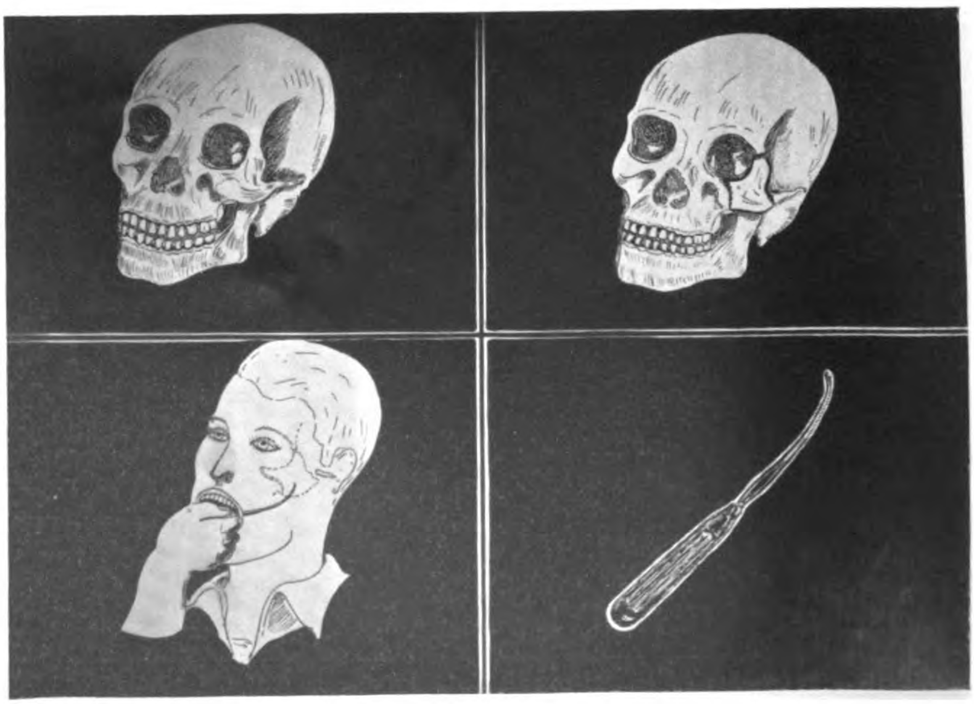

FIGURE 7

into the internal malar surface, figure 7. With the working end of the instrument in the position thus described, the shaft protrudes from the oral cavity at the angle of the mouth in such a manner that strong traction can be applied to bring the malposed malar into position.

Some cases of head injury show considerable comminution of the various facial bones and in instances an actual loss of bone with which the soft tissues are supported. In order to simplify and facilitate subsequent reparative surgery the lost bony support of the soft tissues should be replaced by some type of prosthetic appliance. Various kinds of splints and plumpers are utilized for this purpose.

For the crushed and comminuted nasal bones, Kazanjian favors a nasal splint which derives anchorage from the upper teeth, providing such teeth are free from injury and suitable for the purpose. Another point of anchorage may be provided by a bar extending down from the midsection of a forehead headgear.

The matter of importance is not so much the type of splint used but the maintenance of the soft tissues in as nearly a normal position as possible, regardless of the device employed. Bone grafts, cartilage transplants or plastic surgery can thus be more expeditiously carried out at a subsequent date.

FRACTURED MAXILLAE

DESCRIPTION OF AN APPLIANCE FOR REDUCTION AND FIXATION WITH A CASE REPORT[1]

By Lieutenant Commander H. G. RALPH, Dental Corps, United States Navy, and Lieutenant MERRITTE M. MAXWELL, Dental Corps, United States Navy.

Of the fractured jaw cases which the dental officer is called upon to treat, it is believed that those cases in which there is a transverse fracture of the maxillae, associated with a fracture or fractures of the mandible, belong to the more difficult class. The problem here presented is not only to obtain satisfactory occlusion of the teeth, but to restore, as nearly as possible, a normal anatomical relationship of the displaced and sometimes freely movable fractured parts. In certain cases of impacted fractures, a method of traction must be employed to obtain reduction. It is obvious that the teeth, which may be present, can be brought into normal centric occlusion by means of an interdental splint, but yet there may be a marked discrepancy in the vertical, as well as the horizontal, dimensions of the head and face.

The ends sought are: 1. Satisfactory occlusion of the teeth, or, in the case of an edentulous patient, an optimum relationship of the dental ridges for the accommodation of dentures. 2. Reestablishment of normal facial contour.

Hence there is presented the necessity for a type of splint which affords a considerable latitude of adjustment in all directions, with

[1] Clinical Photography by D. W. Moyer, pharmacist's mate, second class, United States Navy.

anchorage being secured by means of a plaster of Paris head cap or other type of headgear.

Much has been written in the literature concerning appliances for the reduction and immobilization of these cases, notably the older types, such as the Kingsley and modified Kingsley splints, and the more modern contrivances, described by S. V. Mead and Ivy & Curtis.

It is believed that the simplest and least cumbersome type of appliance which will accomplish reduction and permit fixation of the fractured parts will prove advantageous for the following reasons:

1. It provides maximum comfort to the patient.
2. It permits a higher degree of oral hygiene.
3. It supplies the operator with an appliance which is easy of application and subsequent adjustment.

An appliance designed at this hospital is believed to present some merit. It is with the hope that a description of this device, with an attendant case report may be of service in handling certain fracture cases.

The case report cited in this paper will give only the clinical and roentgenographic data essential to a proper understanding of the appliance to be described. Hence such details as the blood findings and other laboratory tests will be omitted.

Case Report

Diagnosis.—Fracture, compound, maxillae, mandible, frontal bone, nasal bones and zygoma (left), traumatic. *J. D. A.*, RM 3–c, age 19.

Admitted to naval hospital, San Diego, Calif., December 26, 1936.

History.—On December 12 the patient was riding a motorcycle and collided with an automobile. He sustained severe head injuries and was taken to a civilian hospital in an unconscious condition. He remained unconscious for 5 days and it was not deemed advisable to move him until December 26, at which time he was transferred to this hospital.

Clinical examination.—Face of the patient is markedly deformed. The nasal bones are crushed and flattened. The infraorbital ridges are bilaterally fractured. Left maxilla comminuted, the anterior wall of the left maxillary sinus crushed. Immediately below the supraorbital ridge, in the median superior aspect of the right orbit, is a puncture wound, from which exudes a seropurulent discharge. Lacerations about the forehead, nose, and chin have been sutured.

Intraoral examination.—Transverse fracture of both maxillae, with two vertical fractures, presenting the upper dental arch as three freely movable segments. Fracture of the hard palate with rupture of the soft tissues leaving an opening, about the size of a quarter, into the nasal cavity. (fig. 8, A and C). The maxillae are apparently depressed posteriorly. Teeth numbers 9 and 12 are evulsed. The mandible is fractured in the following areas: 1. Through the region of the symphysis. 2. Through the right ramus or condyle. Teeth numbers 26 and 24 are evulsed (fig. 8, B and D). There is evidently some comminution of bone at the site of the fracture to the left of the symphysis, the bone ends being visible, and fragmentation palpable through the intraoral tissues.

Roentgeongraphic report.—There is fracture of the nasal bones at their articulation with the nasal notch of the frontal bone. There is fracture across the medial portion of the orbital plate and ridge of the left frontal bone, with fracture into the frontal sinus.

There is fracture across right superior maxilla from nasal notch to the inferior margin of the zygomatic process, with fracture line involving the orbital ridge and surface.

There are fractures across the condylar neck of the right mandible, and coronoid process. Lower fragment displaced medially one full diameter.

There is fracture across the left mandible approximately 1.0 cm from the symphysis. The left body of the mandible is elevated about 1.0 cm and there is separation of the fractured parts of approximately 0.5 cm.

There is fracture across the mid-portion of the left zygoma.

Clinical record.—On January 4, 1937, the physical condition of the patient was deemed satisfactory for the application of a splint. The following technic was employed in construction of a vulcanite interdental splint:

1. Impressions of upper and lower dental arches taken with Dentocoll.
2. Models poured and separated (fig. 8, A and B).
3. Models separated by sawing through fracture lines (fig. 8, C and D).
4. Separated parts of models reassembled, so that, insofar as possible, the teeth are brought into their normal occlusal relationship with establishment of normal arch form. The facets of the teeth serving as a guide to normal centric occlusion (fig. 8, E and F).
5. Constructed models (E and F) placed on articulator with the teeth in arbitrary centric occlusion.
6. Models tinfoiled.
7. Wax pattern for splint constructed by adapting and carving wax about the buccal, labial, and lingual surfaces of the teeth. Occlusal surfaces of the teeth must be in contact through the wax pattern, so that when union occurs patient will have a satisfactory occlusal relationship of the teeth. Brass escutcheon pins (⅜ by 18) with rounded heads are cut in half and inserted in the wax pattern at three-fourths inch intervals along the mid-buccal periphery of the pattern. The brass pins are for the accommodation of intermaxillary elastics, after application of the splint. In the median line of the wax pattern is imbedded a flat hexagonal brass machine nut, fine thread series (10 by 32), for the fixation of the splint rod to the splint proper.
8. Splint pattern vulcanized, trimmed and polished (fig. 9, B).
9. Vulcanite splint tried on models to determine if it accurately fits the teeth. Necessary adjustments for perfect adaptation to the models made at this time.

In cases where there is no fracture of the mandible, immobilization of the lower jaw is obviously unnecessary. The splint is constructed as above, omitting the escutcheon pins, since the only purpose of these pins is to retain intermaxillary elastics extending to the lugs of an arch bar, which has been applied to the teeth of a fractured mandible. In the case of an intact mandible, the patient may be permitted to masticate, to a limited degree, by the lower teeth contacting their respective indentations on the inferior surface of the fixed splint.

In the case reported here, there was a compound fracture of the mandible. Hence we shall continue with a description of the method of fixation employed.

An arch bar (Jelenko fracture splint) was adapted and contoured to the teeth of the lower reconstructed model (fig. 8 F). Adjustment of the bar to the teeth is thereby minimized. We shall pass over the technique of securing the bar to the patient's teeth, inasmuch as this phase of the procedure is commonplace and familiar (fig. 9, A).

At this point, we shall assume that the arch bar is ligated to the patient's teeth, thereby bringing the fractured parts of the body of the mandible into their approximate normal relationship. Further reduction is obtained through the medium of the intermaxillary elastics bringing the lower teeth into their respective indentations on the under surface of the vulcanite splint. The finished vulcanite splint is cemented in correct position on the upper teeth, thus coaptating the fractured parts of the maxillae.

It now becomes necessary to attach the vulcanite splint to some adjustable type of headgear, which will facilitate the restoration of normal facial and jaw relationships. The ideal would be represented by having the teeth in normal centric occlusion with the condyles in their normal positions in the glenoid fossae. Condylar position and success in reduction may be checked by roentgenograms. Palpation over the lines of fracture will also serve as evidence that normal bone contour has been reestablished; displacements may be clearly palpable.

The headgear employed is composed of the following parts (fig. 10):

1. *Two lateral face bars.*—One for each side of the face. These are made of aluminum strips (9½ inches long by ¾ inch wide by ⅟₁₆ inch thick). With bending pliers and plate scissors these may be cut, contoured and notched for adaptation and retention in a plaster head cap. The plaster cap is made in the orthodox manner with the upper notched ends of the bars incorporated therein, so that they approximately parallel each other on either side of the face. Parallelism may be facilitated by placing the face bow rod in position in the swivel retainers.

The lower end of each face bar is provided with a swivel retainer for the retention of the face bow rod. By means of this retainer, which is pivoted at the axis, a limited amount of anteroposterior movement is obtainable. When correctly adjusted for the accommodation of the face bow rod, the retainers are fixed by tightening the knurled nuts. Slots in the swivel retainers serve as sleeves for the free ends of the face bow. Machine set screws, when tightened, set the face bow in its desired vertical position.

2. *Face bow.*—Made from a duraluminum rod, three sixteenths inch in diameter, and composed of two lateral arms and a horizontal part. The lateral arms fit snugly in their respective sleeves in the swivel retainers, while the horizontal part is curved to form an arc across the front of the face, above the resting lip line.

3. *Adjusting block.*—Made from a duraluminum block, the base being one-half inch square by three-fourths inch in height (fig. 10). Through the block two holes are drilled, the upper hole or sleeve is for the passage of the median section of the horizontal part of the face bow. The lower sleeve accommodates the free end of the splint rod. Machine screw secures the adjusting block to the face bow and screw fixes the splint rod in position.

4. *Splint rod.*—Made from a duraluminum rod, $\frac{3}{16}$ inch in diameter, and approximately 1½ inches in length. One end is threaded to screw into the machine nut, which has been vulcanized in the median line of the interdental splint.

From the foregoing description it will be noted that the assembled head gear, as illustrated by figure 11, is capable of a considerable latitude of movement in all directions. The function performed may be compared to that of a universal joint, and once the fractured maxillae are in the desired position, the appliance may be fixed by means of the set screws. Subsequent adjustments are easily accomplished, as may be necessary, in view of roentgenogram and other check-ups.

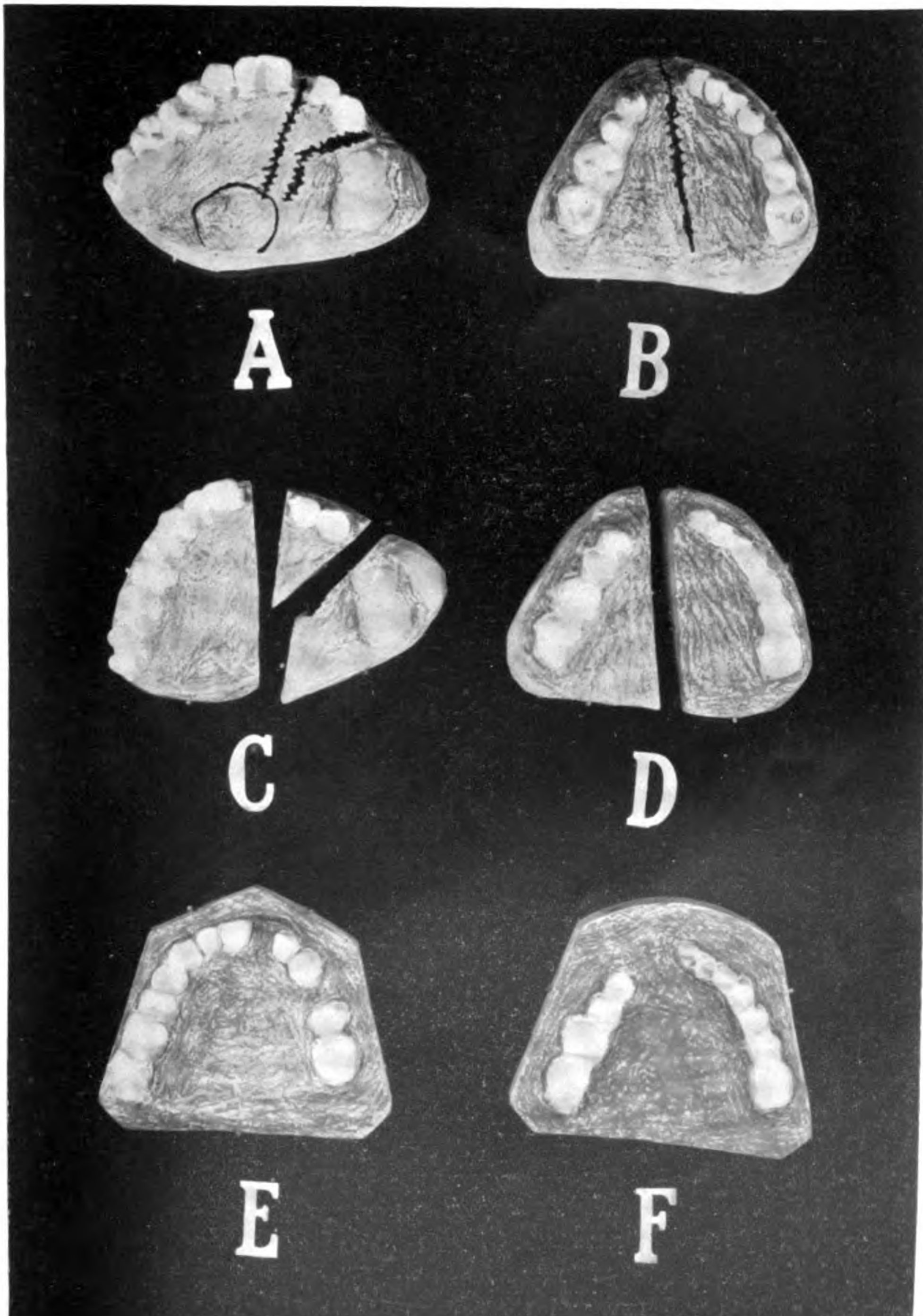

FIGURE 8.

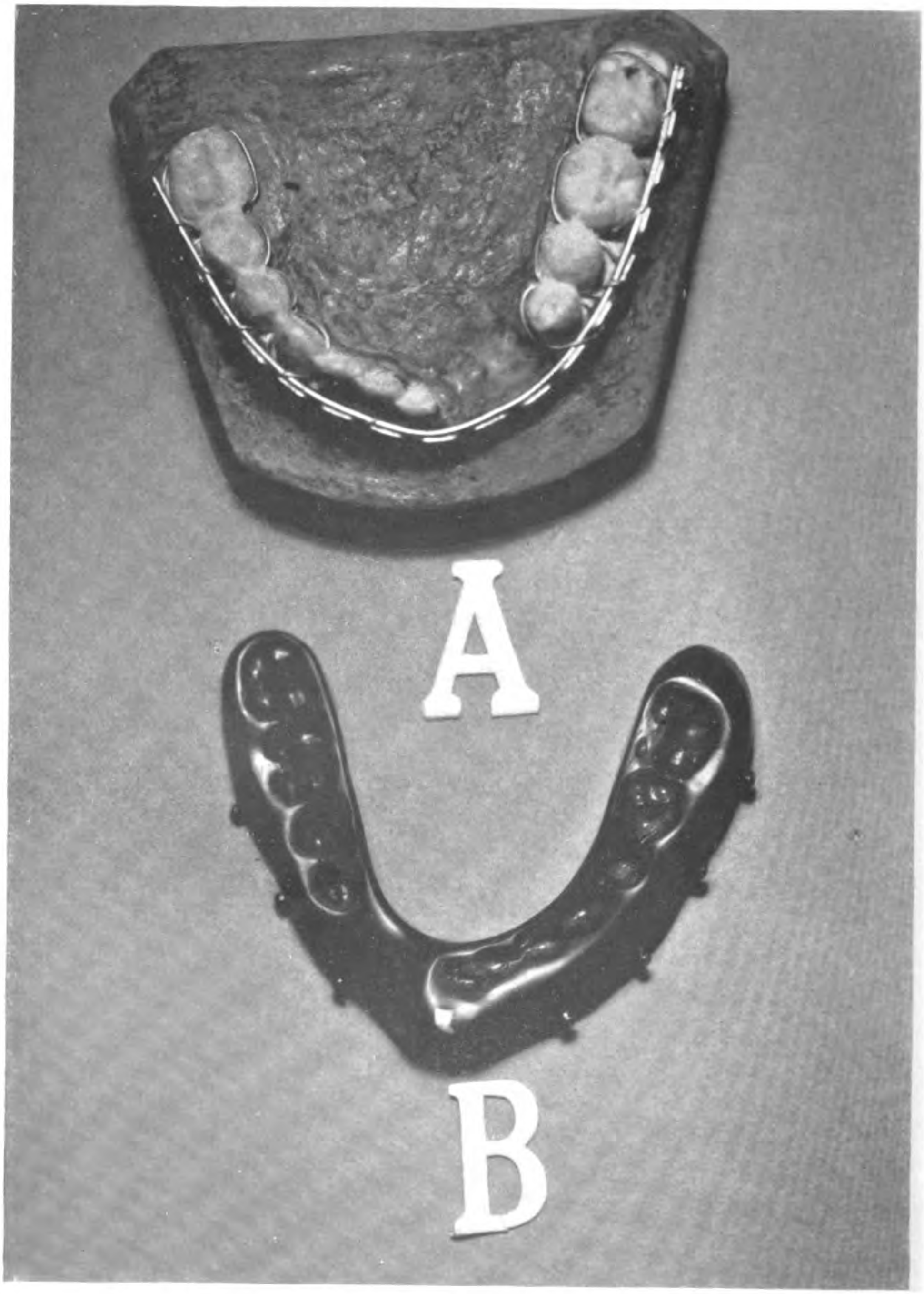

FIGURE 9.

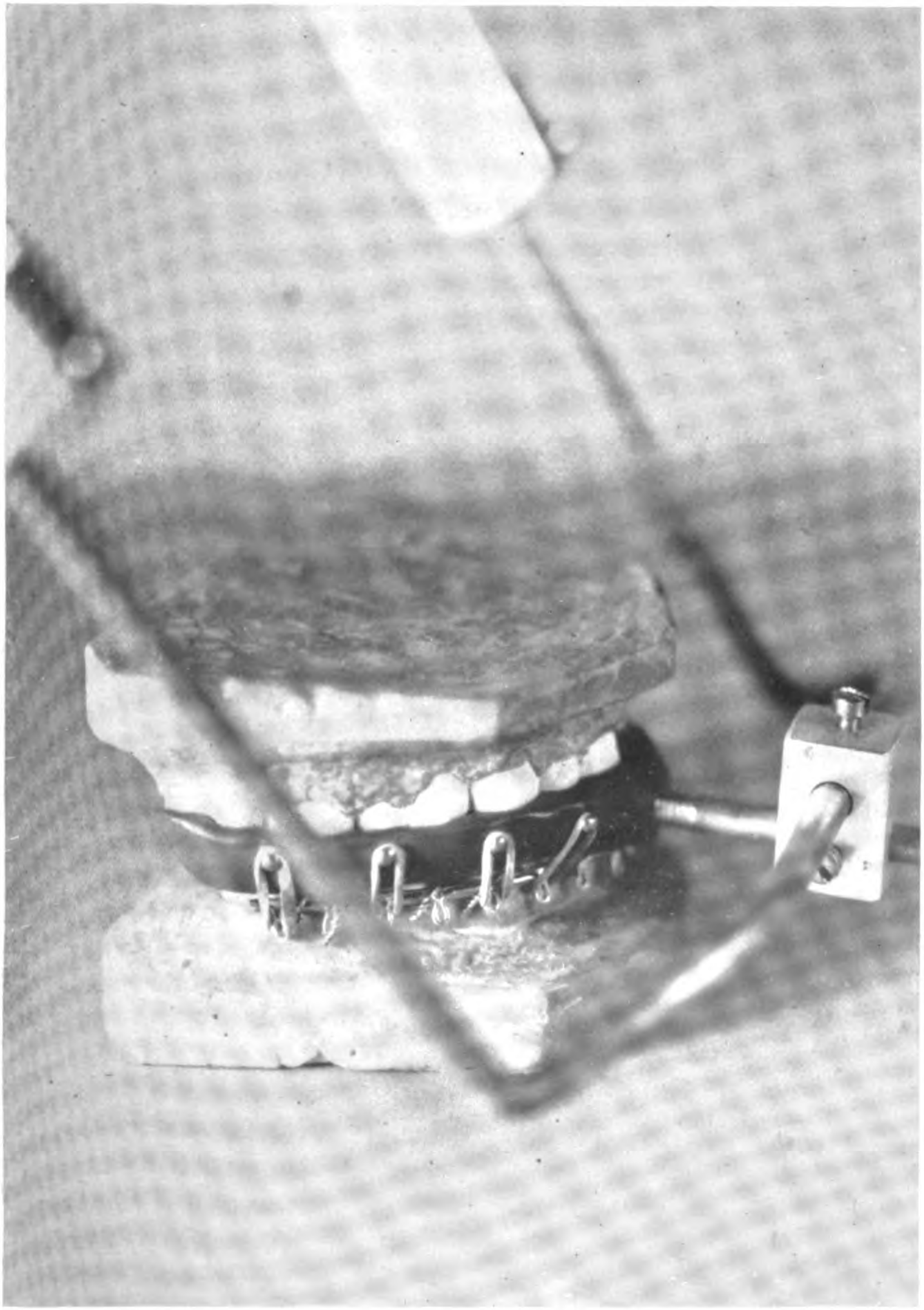

FIGURE 10.

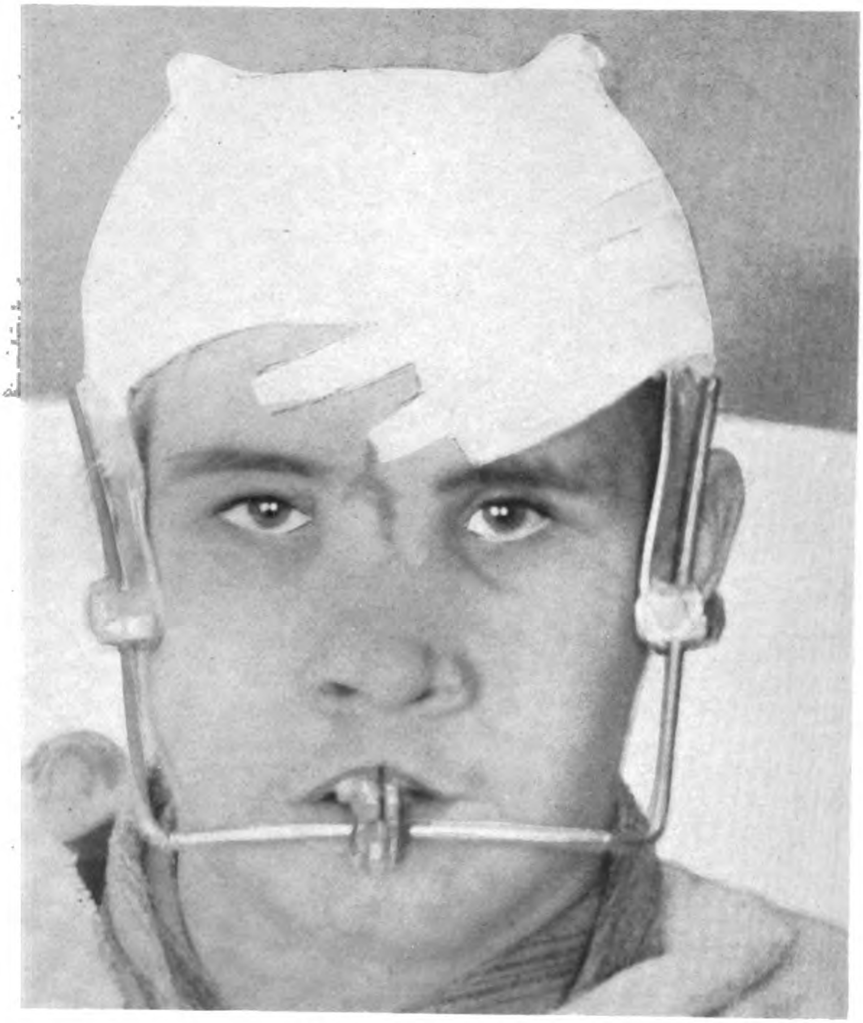

FIGURE 11.

FIGURE 12.

A moderate degree of spring is permitted by the assembled appliance, hence where gradual reduction by traction is necessary tension may be applied as indicated.

To recapitulate.—The arch bar is ligated to the patient's lower teeth. The vulcanite splint is cemented in place over the upper teeth. The lateral face bars are paralleled on either side of the face, and secured within the plaster headcap.

It now becomes necessary to insert the free ends of the face bow in their respective slots in the swivel retainers. The splint rod is inserted through its sleeve in the adjusting block and the threaded end of the rod screwed snugly into the machine nut.

The bilaterally fractured maxillae are brought forward into what is considered to be their normal position and the screws, of the adjusting block and swivel retainers, are set.

A check-up by means of roentgenograms, palpation, and observation as to occlusion, facial dimensions and contour, will aid in determining the success of the reduction. Traction and subsequent adjustments may be made as indicated.

When the maxillae are considered to be in their normal position and immobilized, the intermaxillary elastics are applied between the lugs of the lower arch bar and the brass pins of the interdental splint.

In cooperation with the rhinologist, it may be advisable to add an anterior bar extending down from the plaster head cap for the splinting of fractured nasal bones.

The appliance described is believed to be of value when used in selected cases of horizontal fracture of the maxillae. However, inasmuch as fractures of the facial bones are so varied, certain modifications must be worked out for special cases.

APICOECTOMY

GENERAL CONSIDERATIONS AND SUBSEQUENT ROOT-CANAL THERAPY

By Lieutenant R. W. TAYLOR, Dental Corps, United States Navy [1]

The purpose of this paper will be to present a time-saving technique for the treatment of upper anterior infected teeth. Due to the large number of patients each dental officer must see, time becomes a very important consideration. The following technique consumes on the average of from 1 to 1½ hours. This is for the complete operation and includes the apicoectomy, root canal therapy, and filling. In discussing the operation of root resection, no attempt will be made to credit or discredit the pulpless tooth as a factor in the etiology of disease, or to prove or disprove the regeneration of bone in the presence of bacteria. Nor will we consider how much time must elapse before a sterile pulpless tooth becomes reinfected. The indications and contra-indications for root-canal therapy will also be omitted.

In any surgical operation or root-canal therapy, an aseptic technique is of vital importance. Insist that all towels and sponges be sterilized in an autoclave. Towels as they are returned from the laundry have passed through many hands before they are placed upon the patient. Sponges should be kept in sterile containers and

[1] Acknowledgment is due Lieutenant (Junior Grade) L. W. Colton, Dental Corps, United States Navy, for his assistance in taking the photographs.

placed upon a sterile towel on the bracket table with a sterile instrument. All instruments should be boiled, dried with a sterile towel, and transferred to a sterile tray. They are then covered with a sterile towel and are ready for immediate use. If this procedure isn't possible, then all instruments should be sterilized before each operation and transferred directly to the bracket table.

It must be understood that the following method of treatment is intended only for those upper anterior teeth in which ordinary root-canal therapy might well be contra-indicated; that is, where a dry canal cannot be established because of seepage. This method can be followed also in the case of an acute alveolar abscess where the roentgenogram exhibits a radiolucent area at the apex of the root. The first step in the operation is to establish adequate drainage. Allow several days to elapse, during which time the acute symptoms will subside and the apicoectomy can then safely be performed. After anesthetizing the patient, a rubber dam is applied, including two teeth on either side of the one to be operated. The top of the dam or that section next to the upper lip is folded over so that the lip may be raised. Several 2 by 2 sterile sponges are placed under the lip on each side of the oral cavity. (See fig. 12.) This isolates the field of operation and also prevents blood from escaping into the patient's mouth. The area between the sponges is now painted with iodine. A semilunar incision is made in the muco-periosteum just below the apical region and the flap retracted. Using a chisel or bur, a fairly large window is cut in the bone overlying the apex of the root being amputated. When the apex of the root and pericementum are irreparably injured the cementum and dentin become exposed and infected. There is often evidence of root resorption. When this condition is present, all the affected area of the root should be removed. The amputation can be done with a bur and the stump smoothed with a fine stone. The granuloma is now thoroughly removed with curettes. The cavity in the bone which was formerly occupied by the root apex and granulation tissue is tightly packed with iodoform gauze. The top of the rubber dam is now pulled up over the upper lip and fastened as in any root-canal operation. The exposed crowns of the teeth and surrounding dam are painted with iodine and alcohol. The pulp tissue is removed and the canal thoroughly cleaned. As the pus at the apex of the root has been eliminated and the bone cavity packed with iodoform gauze, the canal may now be thoroughly dried. The canal is next flooded with as highly a concentrated or caustic medicament as desired. There remains no tissue at the apex of the root to be damaged and the gauze protects the bone. There will be no seepage from the apical area into the canal to dilute the medicament. When the canal has been sterilized to the operator's satisfaction it may be filled with any material

which will hermetically seal it. Great pressure may be used in filling the canal, thereby obtaining good condensation as the excess material goes into the iodoform gauze. The permanent filling or restoration is inserted at this time. The top of the rubber dam is again folded down and the lip elevated. The iodoform gauze is removed along with the excess root filling material. If gutta-percha has been a part of the root filling, a hot instrument is used to seal the apical end. The root stump is silver nitrated and the bone cavity touched with phenol, which is quickly followed with alcohol. The periosteal flap is sutured in place, and in no case so far has it been necessary to use a drain.

The results obtained by this method have been very gratifying. In a number of cases follow-up roentgenograms have been made every few months over a period of 2 years and in all cases there has been complete regeneration of bone in the apical region.

SUMMARY

1. It is admitted that the treatment of infected pulpless teeth must be considered doubtful. However, because of the evidence of complete repair as exhibited clinically and roentgenographically an attempt to save these teeth may be justified in selected cases.

2. In this method of operation a reversal of procedure is employed, in that the root resection is done first, followed by the root-canal therapy, thereby gaining the advantage of a dry canal.

HEALING TIME IN FRACTURES OF THE MANDIBLE

By Lieutenant C. C. Welch, Medical Corps, United States Navy, and Lieutenant R. W. Taylor, Dental Corps, United States Navy

The purpose of this paper will be to present a few observations on the healing time of fractures in the mandible, both from a clinical and roentgenographic viewpoint.

On several occasions we have seen jaws immobilized because there was a history of an injury and the roentgenogram exhibited a fracture line. Upon further examination it was discovered that the fractures reported roentgenographically were old ones and that there had been good union for weeks. Diagnosing a fracture of the mandible isn't usually a very difficult procedure, especially if a good set of roentgenograms is available. However, there are times when a diagnosis is made from the roentgenogram alone and this can result in much embarrassment. If an accurate diagnosis is to be arrived at, one must not depend solely upon a roentgenographic examination but must include a thorough clinical examination plus a careful history as necessary phases of the routine.

The roentgenogram is a very valuable aid in determining the location of the line of fracture, position of fragments, and relation of tooth roots. During treatment it exhibits the presence of sequestra and callus formation. But, in the roentgenogram, callus formation in the

immobilized mandible differs from that seen in some of the other bones of the body. In the mandible where there is little movement and not too great separation of the parts, there is an absence of such extensive peripheral callus as is present in the femur, for instance. It has occurred several times, that after a fracture has been immobilized for several weeks, a check up roentgenographic report will return with the information that there is no evidence of either callus or new bone formation. Nevertheless, in these cases, upon the removal of the fracture appliances good union of the parts was found.

It has been stated that the mandible and zygoma are membrane bones derived from the old exoskeleton or dermal bone. These bones develop in membrane, and are, in growth and fracture repair, fundamentally different from the endoskeleton with its endochondral type of ossification and cartilaginous method of fracture repair.

Grimson [1] in his experiments on dogs found the following conditions existing: The fracture of the zygoma with the ends fixed in close apposition healed rapidly by a condensation of the intermediary fibrous callus into bony trabeculae. There was little or no peripheral or periosteal callus. Five fractures of the zygoma that were widely separated, and all of the fractures of the mandible, developed a fibrous intermediary callus with little new bone and an extensive peripheral callus with large amounts of new bone. No method of immobilization was used in this experiment. The relative difference in the amount of motion present may explain the large amounts of periosteal callus in the mandible and the small amounts in the zygoma. Three cases in the human mandible which came under our observation exhibited slight amounts of periosteal callus formation. These cases were also incompletely immobilized.

Several authors have made the statement that they remove their fracture appliances after 4 or 5 weeks and by that time they feel there is bony union of the parts. Before making further comment, however, let us consider the time involved in the calcification of extraction sockets.

Claflin [2] has found that healing of extraction wounds in dogs with special reference to bone changes are as follows: 1. First appearance of osteoclasts, 3 days; 2, first bone formation, from 5 to 7 days; 3, new bone reaching the alveolar crest from 11 to 15 days; 4, sockets filled with bone (except central portion), from 15 to 22 days; 5, bone at crest levelled off, from 28 to 31 days. These findings correspond very closely with the findings of other investigators.

The fact has been demonstrated histologically that new bone formation in extraction wounds of dogs takes place in the same manner as in man—only much more rapidly.

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[1] Grimson, K. S. Healing of Fractures of the Mandible and Zygoma. J. A. D. S. and Dent. Cos. September, 1937.

[2] Claflin and Steinhardt. Healing of Disturbed and Undisturbed Extraction Wounds. J. A. D. A., June 1936.

Steinhardt reports two cases in man in which death in the first occurred 3 weeks after extraction of the teeth. In the histologic specimens, the socket was filled with young granulation tissue and the fundus with uncalcified bone. He compares this to a 9-day old extraction wound in a dog. The next extraction wound which he describes histologically was an alveolus of a lower bicuspid, 3½ months old. The depth of the alveolus was greatly reduced by the presence of new bone. The central portion still contained remnants of the original blood clot. This corresponds to an 8-week extraction wound in a dog.

Claflin reports histologically a 6-week old extraction wound in a human jaw of a lower molar in which the two sockets were well filled with granulation tissue but only a small amount of new bone is found in the fundi.

We have noticed that when teeth in line of fracture are removed prior to reduction, roentgenographically the alveoli become obliterated before the disappearance of the fracture line.

From the above evidence it seems quite plausible to assume that calcification is completed in the extraction socket more rapidly than in the fracture line. This then being the case, it is highly improbable that in the human jaw, bony union can be present at the end of a few weeks. We feel it is only a fibrous union. It has been our observation that it requires from several months to several years in some cases for complete recalcification of bone in the fracture line and obliteration of this line roentgenographically. Our findings in the mandible are similar to those described by Vance [3] in fractures of the skull. It is his impression that fractures in adult skulls disappear roentgenographically in about 2 years. In children the time is much more variable, but the average time is probably 1 year, except in very young children where complete healing may take place in 4 months.

It is of interest to note that the fracture line finally completely disappears and becomes the same density as the surrounding bone. As the healing takes place the margins of the fracture lines become less sharply outlined, also there is a change in the density of the intermediary zone, thus rendering the fracture line less distinct. Column five in the table records the time in our series in which the fracture lines, although still clearly visible are repaired sufficiently to enable them to be recognized as old fractures. As will be seen the average time was approximately 4½ weeks.

There are many factors which might either directly or indirectly influence the healing time of fractures. Only a few most likely to pertain to the mandible will be mentioned here. Delay in the reduction of the fracture is one factor which should be eliminated as much as

[3] Vance, R. G. The Healing of Linear Fractures of the Skull. Am. Jour. Roentg. Rad. Therapy, 36: 744; December 1936.

possible. A fresh fracture is much easier to reduce than an old one and the longer the delay the greater the chance of an infected wound. Poor approximation of fragments, or insufficient fixation retards healing or may cause nonunion. It is our opinion that for the first 2 or 3 weeks fractures should be securely immobilized, allowing no movement of fragments.

It is difficult to lay down a set of rules or generalize regarding the procedure to follow in the treatment of fractures where teeth are in line of fracture. However, it has been our experience that considerable trouble may be encountered by failing to remove such teeth. There are times when for various reasons these teeth cannot be extracted, but it has been our observation that the majority of infections associated with fractures have resulted from leaving these teeth undisturbed. Whenever conditions permit, they should be removed prior to the reduction of the fracture.

CHART

Case No.	Date injured	Width of separation	Wired, weeks	X-ray evidence of repair, weeks	To duty, weeks	Fracture lines (roentgenographically)		
						Plain	Faint	Absent [4]
1	Feb. 21, 1937	Slight	5	4	8		8 weeks	
2	Aug. 8, 1936	do	4	4	4	4 weeks		
3	Oct. 2, 1937	do	3	4	4	4 weeks		
4	Feb. 19, 1936	0.1 centimeter	4	5	5	5 weeks		
5	Sept. 18, 1937	0.3 centimeter	2	3	4	4 weeks		
6	May 13, 1937	Slight	3	3	4		4 months	
7	July 29, 1937	do	3	3	3	3 weeks		
8	Apr. 22, 1937	do	4	4	4	4 weeks		
9	Jan. 6, 1937	do	7	7		4½ months		
10	May 5, 1936	do	4	4	7	1 month		
11	May 12, 1934	do	5	3	7	2 months		
12	May 24, 1933	do	4	4	5	1 year		
13	Apr. 6, 1933	0.3 centimeter		8	12	10 months		
14	Nov. 5, 1933	Slight	6	8	8		2 months	
15	Feb. 26, 1934	0.4 centimeter	5	6	7	6 months		
16	May 24, 1933	Slight	4	4	5		1 year	
17	May 23, 1934	do		6	7	7 weeks		
18	Mar. 15, 1935	Separated			36	9 months		
19	Feb. 22, 1936	0.1 centimeter	6	6	9		10 months	
20	Nov. 22, 1934	Slight	5	6	7	7 weeks		
21	Oct. 31, 1936	0.1 centimeter	7	5	9		6½ months	
22	Mar. 5, 1936	Slight					6 months	
23	Feb. 27, 1936	0.6 centimeter	11	7	12	8½ months		
24	Feb. 14, 1936	0.4 centimeter	11	4	12		7 weeks	
25	Oct. 31, 1936	Slight	7	5	9		2 months	
26	Feb. 6, 1937	do	6	5	8			8 months.
27	Aug. —, 1936	do	8	5	11			11 months.
28	May —, 1934	Overlapped						3 years; 5 months.
29	Apr. 13, 1934	Comminuted						3 years.
30	Mar. 5, 1934	Separated			9	9 months		

[4] Time it took line to become obliterated.

Infection does interfere with healing to a certain extent but union of the parts usually takes place in spite of it. Adequate drainage is necessary and the removal of the cause which will be, generally, a detached fragment of bone or tooth in line of fracture. We have seen osteomyelitis develop in very few jaw fractures.

SUMMARY

1. Healed fractured jaws have often been immobilized because too much reliance was placed on the roentgenogram and old fracture lines have been mistaken for fresh fractures.
2. In the immobilized mandible callus formation differs from that seen in many of the other bones of the body.
3. From available literature and our observations in approximately 200 cases, 30 of which are presented in the chart, we believe fracture appliances are removed in the majority of cases before there is bony union of the fragments.
4. In our present series of 30 cases the average time of immobilization of the fractures was 5½ weeks; average time for roentgenographic evidence of repair, 4½ weeks and average length of time patient was incapacitated for duty, 8 weeks.
5. Roentgenographically, fracture lines are clearly visible after patients have regained normal function of the jaws and are returned to duty.
6. There are several factors which affect the healing of these fractures. Probably the most important of these is the tooth in the line of fracture. Whenever conditions permit we believe it advisable to remove the teeth in the fracture line.
7. We have found that the majority of compound fractures require very little more time for healing than do simple fractures and that a high percentage of jaw fractures if carefully examined are compound fractures.
8. It has been our experience that infection in fractures of the mandible occurs in only a small percentage of cases.

INHALATION ANESTHESIA [1]

PHYSIOLOGIC CONCEPTS UNDERLYING RECENT PROGRESS

By Lieutenant Albert R. Behnke, Medical Corps, United States Navy

The striking advances made in the administration of inhalation anesthetics during the past 10 years consist mainly in the use of the closed or carbon dioxide absorption method, the increased employment of carbon dioxide as a circulatory and respiratory stimulant, and the prevention of arterial anoxemia. These advances have

[1] Summary of a paper delivered at the annual meeting of the Medical Association of the Territory of Hawaii, May 1, 1937.

transformed a previously indolent art into a highly developed specialty, a specialty whose importance has too frequently been overlooked by the surgeon and internist.

The purpose of this paper is to present a number of physiologic implications connected with the recent progress in the field of inhalation anesthesia.

The carbon dioxide absorption method of administering anesthesia provides for the rebreathing of anesthetic gases in a closed system, so that surgical anesthesia once induced can be maintained with little or no additional gas. Provision is made for the absorption of the exhaled carbon dioxide and for the addition of oxygen. Underlying this method is the principle consisting of the rapid establishment and maintenance of equilibrium between a constant gas tension in the lungs and the tension in the blood and other tissues. The advantages of this procedure according to Woodbridge[2] are that breathing is much quieter, the patient's energy is conserved, loss of heat and fluid in the exhaled gas is minimized, and the exhaled gases (frequently explosive and malodorous) are not thrown out into the room in large volume.

In considering the physiologic implications involved in the carbon dioxide absorption method we shall examine first the manner in which the body absorbs inhalation anesthetics. According to our present knowledge the anesthetic gases are chemically indifferent and owe their narcotizing ability probably to some unexplained physical property. The Meyer-Overton concept postulates that for anesthetics of the aliphatic series a definite relationship in narcotic efficiency exists in the ratio between the solubility of the substance in water and its solubility in fat. Of the many hypotheses attempting to explain narcosis this concept preeminently gives the anesthetist a working principle toward an understanding of narcotic action.[3]

Of great practical value, however, is the fact that the inhalation anesthetics are eliminated without alteration almost completely from the body in the manner in which they were absorbed. Thus, in their absorption and elimination they act as any inert gas coming in contact with the lung epithelium. They, therefore, can be compared with the nitrogen in the air which is dissolved in the body in proportion to its partial pressure in the lungs. The air nitrogen fortunately can be easily measured as it is eliminated from the body during oxygen breathing.[4]

[2] Woodbridge, P. W.: Recent Experiences and Present Trends in Anesthesia. Surg. Clin. N. A., 1513, December 1935.

[3] Henderson, V. E.: The Present Status of the Theories of Narcosis. Physiol. Rev. 10: 171, 1930.

[4] Shaw, L. A., Behnke, A. R., Messer, A. C., Thomson, R. M., and Motley, E. P.: The Equilibrium Time of the Gaseous Nitrogen in the Dog's Body Following Changes in Nitrogen Tension in the Lungs. Amer. Journ. Physiol., 112: 545, July 1935.

The curves (fig. 13) obtained by Behnke et al.[5] represent the elimination of the gaseous body nitrogen during a 4-hour period of oxygen inhalation by a young man weighing 132 pounds. Since the nitrogen solvents of the body are water and fat, which in the average person comprise about 70 and 15 percent of the body weight, respectively, the broken line curves B and C can be drawn to represent the elimination of nitrogen from these constituents. If air is now breathed by the nitrogen-free individual, absorption of nitrogen will proceed in the same manner as its previous elimination.[4]

Like the nitrogen of the air, the commonly used inhalation anesthetics—ether, nitrous oxide, ethylene, and cyclopropane—will be

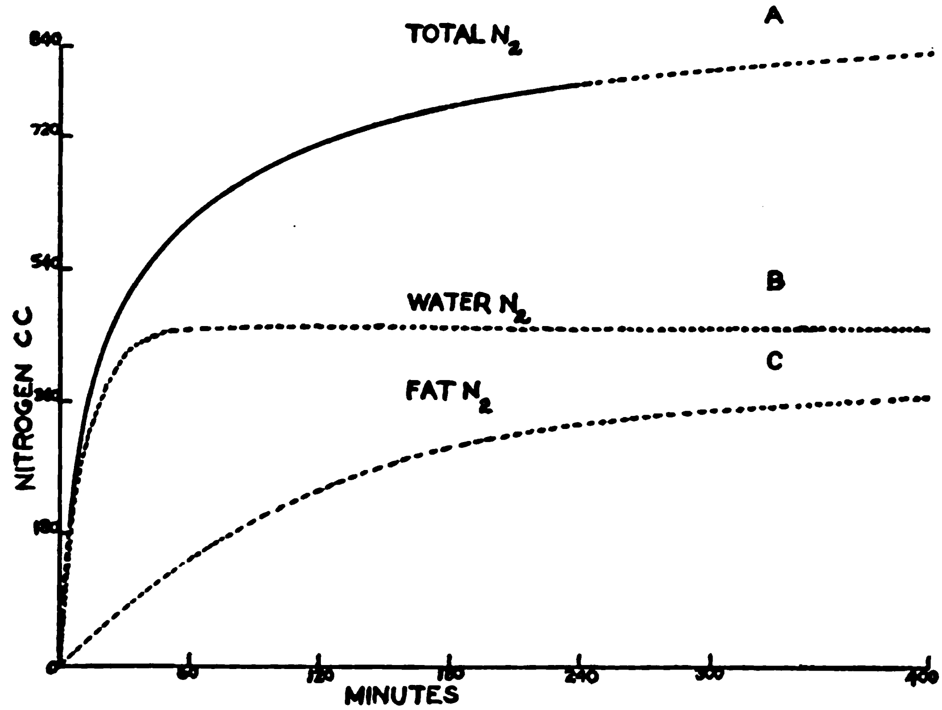

FIGURE 13.

absorbed and eliminated as represented by the nitrogen curves, with variation dependent upon the respective solubility of the gases in fat and water. Ether, for example, has a water-fat solubility ratio only about one-third less than that for nitrogen. The curves of the graph indicate that the body fluids will reach complete equilibrium with a given tension of ether in arterial blood in about 15 minutes. The body fat, however, continues to absorb ether over a period of 6 hours. Hence, even in a closed system where only a small amount of gas may be lost, appreciable quantities of ether vapor must be

[5] Behnke, A. R., Thomson, R. M., and Shaw, L. A.: The Rate of Elimination of Dissolved Nitrogen in Man in Relation to the Fat and Water Content of the Body. Amer. Jour. Physiol., 114: 137, December 1935.

periodically added in order to maintain the required anesthetic tension in the lungs and blood stream.

Reference should be made at this point to the basic studies of ether absorption by Shaffer and Ronzoni,[6] and Haggard.[7] On the basis of their quantitative data it should be pointed out that one of the difficulties of inducing anesthesia with ether results from the high distribution coefficient of this anesthetic in the blood stream as compared with the lungs. In order to maintain an ether tension of 21 mm in the arterial blood, 45 volumes percent of ether gas must be dissolved in the blood in relation to the 3 volumes percent present in the alveolar air. Rapid induction with ether anesthesia is dependent, therefore, upon increased lung ventilation, and an initial concentration of ether in the lungs far in excess of the anesthetic blood tension.

The small quantity of ether and other anesthetic substances necessary for the maintainance of anesthesia in a closed or carbon dioxide absorption system should be stressed. With a 3-percent anesthetic concentration of ether in the lungs not more than 61 grams could be absorbed by the body fluids nor more than 43 grams by the body fat in an individual weighing 154 pounds. Expressed in terms of volume, 146 cubic centimeters of liquid ether or 31 liters of ether vapor would maintain anesthesia indefinitely. For anesthesia of 1 hour's duration 100 cubic centimeters of ether should suffice. Of ethylene the anesthetized patient would absorb no more than 14 liters, of nitrous oxide 32 liters, and of cyclopropane 8 liters.

The increased employment of carbon dioxide and of carbon dioxide-oxygen mixtures marks a second advance in the recent progress of anesthesia. The use of carbon dioxide as a respiratory stimulant is too well known from the studies of Yandell Henderson to require further comment. Recent experiments in addition have shown the value of carbon dioxide as an augmenter of cerebral circulation [8] and hence as a means of rapidly removing narcotic gases from the central nervous system Behnke et al.[9] were able to show that by adding 8-percent carbon dioxide to the pulmonary air, the pial vessels of the cat exposed by trephining the skull according to the method of Forbes [10] could be made to dilate as much as 30 percent. Shaw and his coworkers,[11] moreover, effectively controlled the toxic effects of

[6] Shaffer, P. A., and Ronzoni, E.: The Determination of Ethyl Ether in Air and in Blood, and its Distribution Ratio Between Blood and Air. J. Biol. Chem., 57: 741, October 1923.

[7] Haggard, H. W.: The Absorption, Distribution, and Elimination of Ethyl Ether. J. Biol. Chem., 59: 737, 1924.

[8] Gibbs, F. A., Gibbs, L., and Lennox, W. G.: Changes in Cerebral Blood Flow Consequent on Alterations in Blood Gases. Amer. Journ. Physiol., 111: 557, 1935.

[9] Behnke, A. R., Forbes, H. S., and Motley, E. P.: Circulatory and Visual Effects of Oxygen at 3 Atmospheres Pressure. Amer. Journ. Physiol., 114: 436, 1936.

[10] Forbes, H. S.: Cerebral Circulation: Observation and Measurement of Pial Vessels. Arch. Neurol. and Phychiat., 19: 751, 1928.

[11] Shaw, L. A., Behnke, A. R., and Messer, A. C.: The Role of Carbon Dioxide in Producing the Symptoms of Oxygen Poisoning. Amer. Journ. Physiol., 108: 652, June 1934.

high oxygen tensions on the nervous system by either raising or lowering the alveolar carbon-dioxide tension. The alert anesthetist, therefore, works on a sound physiologic basis when he administers carbon dioxide not only to "wash out" the anesthetic from the lungs but also to remove the anesthetic gas from the brain by bringing about an increased volume of blood flow.

The most important contribution in present-day anesthesia undoubtedly is the prevention of arterial anoxemia made possible by discriminate preliminary medication, by the addition of ether to the nitrous oxide-oxygen mixture, and by the employment of cyclopropane. It is remarkable that the seriousness of arterial anoxemia associated particularly with the administration of nitrous oxide has almost wholly escaped the attention of the surgeon and too frequently the attention of the anesthetist. The breathing of an 86 percent nitrous oxide-14 percent oxygen mixture and even lower percentages of oxygen is physiologically unsound. Insofar as an oxygen percentage of 14 is concerned, it is equivalent to breathing rarefied air at an altitude of about 14,000 feet. While a surgeon would not prescribe an operation at an altitude of 14,000 feet, he does permit an anesthetist to change in a few seconds the oxygen tension in the patient's lungs from that at sea level to that at the summit of Pike's Peak. He may even allow the patient to breathe a 90 percent-10 percent oxygen mixture, and in condoning this procedure he allows his patient an oxygen tension equivalent to that in the rarefied air at the summit of Mount McKinley.

The necessity of maintaining a normal oxygen tension cannot be too strongly emphasized. While many healthy individuals tolerate a reduction of one-third in the oxygen tension of the inspired air at sea level, a patient suffering from an acute or chronic disease process cannot tolerate the additional burden of anoxemia upon his already harassed circulatory system. Shock due to anoxemia has been repeatedly produced in the laboratory and perhaps as frequently in the operating room. When the percentage of oxygen is allowed to fall below 15, anoxemia rather than surgical trauma may be the cause of shock. The quantitative studies of Eastman [12] proved that there was a definite relationship between nitrous-oxide anesthesia, with oxygen percentages below 15, and asphyxia of the newborn associated with clinical signs of shock.

The introduction of the saturated hydrocarbon cyclopropane (C_3H_6) by Lucas and Henderson [13] in 1929 and its clinical application by Waters, Sise, Woodbridge, and others have tended to divorce anesthesia from asphyxia by making possible oxygen percentages as

[12] Eastman, N. J.: Role of Anesthesia in the Production of Asphyxia Neonatorum. Amer. Journ. Obst. and Gny., 31: 561, April 1936.

[13] Lucas, J. H. W., and Henderson, V. E.: New Anesthetic Gas, Cyclopropane; Preliminary Report. Can. Med. Journ., 21: 173, August 1929.

high as 85. It is indeed a remarkable coincidence that cyclopropane should come into use at a time when thoracic surgery, the most progressive of surgical specialties, required an anesthetic that could be combined with a high oxygen tension. The sparing solubility of this gas in the blood stream gives it a low distribution coefficient (0.5) between the blood and the lungs. In contrast with ether, equilibrium is immediately reached between the tension of gas in the lungs and the tension in the blood stream. Hence, at no period in the anesthesia is it necessary for the gas tension in the lungs to exceed that in the blood stream. This characteristic assures a high degree of safety, since the anesthetic need not be pushed at any stage of its administration. The small amount of cyclopropane necessary for anesthesia should again be mentioned. With the closed technique method of administration less than 8 liters of gas will be absorbed by the body during major operative procedures. Finally, in thoracic surgery or in operations involving the trachea or on the head, the employment of the tracheal catheter and the use of helium in the closed system to reduce the density of the anesthetic mixture rounds out the technique of the present-day anesthetist.

SUMMARY AND CONCLUSION

Physiologic principles have been outlined which underlie the excellent progress made in the field of inhalation anesthesia. Attention was directed to the manner in which anesthetic gases are absorbed, to the use of carbon dioxide to stimulate respiration and cerebral circulation, and to the necessity of maintaining a normal oxygen tension.

Future progress undoubtedly will be characterized by the transformation of the art of anesthesia into a science principally through quantitative studies of absorption and elimination of anesthetic gases to the end that a dosage as precise as that employed in intravenous medication can be prescribed for inhalation anesthetics.

It should be pointed out that the progress made in the administration and development of inhalation anesthesia has been brought about by pharmacologists, and by physicians engaged full time in this specialty. While nurse anesthetists can develop into excellent technicians, the discriminate supervision of anesthesia must be exercised solely by the physician trained in this specialty.

A FORMULA FOR IMMEDIATE CHEMICAL PROPHYLAXIS [1]

By Rear Admiral H. W. Smith, Medical Corps, United States Navy

During the past 4 years, there has been in progress at the Naval Medical School an investigation undertaken primarily to compare

[1] A preliminary report of an investigation conducted in the laboratories of the U. S. Naval Medical School. Received for publication July 22, 1938.

for efficiency and suitability the many substances considered possibly of value in the immediate chemical prophylaxis of venereal disease.

These substances have been studied individually, in various combinations, and in varying proportions. There have been included in the study all compounds and all constituents known to be in use or recommended in available literature during the past 35 years, and also others suggested by participants in the study or by other informed persons--in all some 242 specimens including various vehicles such as ointments, pastes, creams, water-soluble jellies, and solutions.

Since for several compelling reasons it was not feasible to carry out adequate tests of all preparations on animals, a special rapid technique was devised for estimating quantitatively the efficiency of the materials examined. Our findings, being concerned with artificial media and common laboratory pathogens, are not necessarily transferable to human subjects under natural conditions of exposure; but it is believed that they may be accepted as indicating correctly the relative efficiency of preparations the active ingredients of which have been proved by experiment and experience over many years to be effective agents in venereal prophylaxis.

Inasmuch as the base is the vehicle or medium whereby the active ingredients of a preparation are distributed and brought into effective physical contact with whatever pathogenic organisms there may be present on the skin, in its appendages, or superficially in exposed tissues, particular attention was given to the properties of base compounds, upon methods of compounding, upon descriptive specifications covering individual components, and the ultimate effect of various agents upon the finished product observed after prolonged storage at low and at high temperatures.

It has been learned through an extended series of experimental observations that a base comprising Petrolatum-USP and Cholesterol in a certain determined ratio is more effective in promoting activation and clearance of incorporated antisyphilitic and antiseptic substances than any physically suitable ointment base heretofore described or known to the writer. It has been demonstrated further that the efficiency of this base is reduced by any substitution or addition, by any material alteration in the prescribed ratio of its components, and by methods of compounding other than that advised.

A full account of the investigation with detailed description of the methods employed and the collateral physical, chemical, and biological studies upon which our conclusions are based, will be published at a later date, the purpose of this communication being to make known without further delay the formula of the preparation finally adopted.

The distinguishing features of the preparation are—

1. An ointment base of the required physical characteristics which is readily miscible with both fats and watery colloidal solutions, and

which has been found the one most favorable to activity of incorporated agents.

2. A form of calomel about 30 percent more "active" than the USP product.

3. An adjuvant equal to any antiseptic which is compatible with the other ingredients and which does not affect adversely the required physical characteristics of the base.

4. The several other desiderata pertaining to a preparation intended for personal prophylaxis having been adequately met.

FORMULA

	Grams
Mix by trituration without heat:	
Petrolatum USP	98
Cholesterol	2
Of this base	67
Of "Colloidal" calomel	33
Of mercuric cyanide	0.125

ACTIVE IMMUNIZATION AGAINST TETANUS

USING ALUM-PRECIPITATED TETANUS TOXOID

By Captain R. HAYDEN, Medical Corps, United States Navy, and Commander W. W. HALL, Medical Corps, United States Navy

Active immunization is nature's method of protection. All naturally developed immunity to infectious diseases, as well as all immunity developed by vaccination, is ACTIVE IMMUNITY. Passive immunity, on the other hand, although it may be highly effective under properly controlled conditions, is merely stop-gap or substitution therapy and is temporary in nature.

In general, the advantages of active immunization over the passive method of protection scarcely need to be emphasized. The limitations of passive immunization were recognized by the early workers in the field. Soon after the development of diphtheria antitoxic serum, diligent search was begun for a method by which active immunization could be developed. The success attained in the fight against diphtheria by active immunization, and the value of alum-precipitated diphtheria toxoid in producing an active immunity, are attested by complete freedom, in some modern cities, from the menace of childhood diphtheria. The work with active immunization against tetanus can be said to be a direct outgrowth of the methods and procedures followed in the battle against diphtheria.

Both diphtheria and tetanus produce soluble toxins or exotoxins. Both of these exotoxins, when treated with formaldehyde and heat, become nontoxic while still retaining their antigenic powers. These detoxified products were called ANATOXINS by the French, but since have been referred to by English speaking nations as TOXOIDS in order to avoid confusion with the word antitoxin. Both of these toxoids

are precipitated by the use of alum, and, though relatively insoluble, when injected gradually go into solution. Thus, antigenic stimulation is exerted little by little and over a long period of time. Antitoxin developed as a result of this prolonged, smooth, and steady reaction, is eventually much greater in amount than that produced by several injections of soluble and rapidly diffusible toxoid (plain formalized toxoid).

It is understandable that immunization against diphtheria and tetanus should be coupled in our minds, because of the similarities indicated and because of the fact that both were developed by Ramon in the same laboratory. An important difference exists between diphtheria and tetanus however, in that subclinical diphtheria infections do occur and result in natural active immunity, which is demonstrable by negative Schick tests; whereas there does not appear to be any such thing as natural immunity against tetanus. That is, subclinical infections of tetanus, with resulting immunity, do not occur. The complete absence of any titratable immunity in large numbers of sera from unimmunized individuals supports this statement.

Unfortunately, no simple method of determining immunity against tetanus, such as the Schick test in diphtheria, exists. This difficulty has been an essential factor in slowing up the study of active immunization against tetanus by means of alum-precipitated tetanus toxoid. However, the accumulation of data from many different laboratories, and from clinical and field observations, now justifies the conclusion that such induced immunity can be safely relied upon to protect against tetanus, and that this disease, with its high mortality rate, may be practically eliminated from the hazards of mankind.

Although tetanus spores are widespread in nature, even in the dust of a modern city's streets,[1] the importance of tetanus, from a public health standpoint may be considered negligible in civilian life; for deep contused wounds, traffic injuries excepted, are not numerous, and facilities for passive immunization are always available. Furthermore, the common experience of mankind teaches that most wounds heal without tetanus. However, few physicians would have the temerity to take the long chance of witholding an injection of tetanus antitoxic serum. How often have we, as doctors, been faced with this decision: "Shall I give antitoxic serum and risk an immediate reaction or late serum sickness; or shall I let the patient go without serum and risk tetanus? I really do not think that tetanus will occur in this case, but I am not sure. I know that this patient has had horse serum previously and serum sickness. What shall I do?"

It is true that the menace of tetanus is greatly increased in certain occupations. The normal habitat of the tetanus bacillus is in the

[1] Gilles, J. A. M. A., 109:7,484 (August 11) 1937.

intestinal tract of animals, particularly the herbivora. Dubovsky and Meyer[2] even found the spores in virgin forest soil. Because of the great resistance of the spores they are blown about in the dust and are spread everywhere in dirt and manure. Thus, they are found in barracks as well as in hospitals, in clothing, on the skin, and in a great variety of places. Tetanus spores or toxins may contaminate bacterial vaccines, vaccine virus, or therepeutic sera. Unfortunate accidents from the use of such contaminated, improperly controlled, biological products have occurred in this country as well as abroad. Eleven deaths from "cancer treatment," in which such a contaminated serum was used, have recently been reported.[3]

The importance of tetanus in civil life may be small. In warfare, however, the conditions which minimize the importance of tetanus in civil populations are completely reversed, and high incidence of tetanus, with its great mortality rate, becomes a major medical problem. In civil life, wounds are few, often superficial and uncontaminated, and antitoxin is quickly available; war wounds, on the other hand, are notably deep with much devitalized tissue and soil contamination, and serum is often not promptly available.

The accompanying table shows the important role tetanus has played in modern wars.[4]

TETANUS IN MODERN WARS

Military force	Date	Incidence per 1,000 wounded	Mortality (percent)
British Legion in Spain	1833–40	12.5	88.2
British in Turkey and Crimea	1854–56	1.5	82.1
Italian War with Austria	1859–61	10.0	92.4
American Civil War	1860–65	2.0	89.3
German in Franco-Prussian War	1870–71	3.5	90.0
British Expeditionary Force in France and Belgium	1914	5.2	
British Expeditionary Force, total	1915–19	1.5	50.0
German, all fronts	1914	3.8	75.0
German, all fronts	1915–18	.8	51.4
United States in France and United States of America	1917–18	.2	11.1

It will be noted that the incidence of tetanus has varied considerably according to the type of war and the soil pollution in the theater of war. Prior to the World War, in those who contracted tetanus, the mortality rate was close to 90 percent. In the German army, during 1914, when troop movements were rapid and lines not stabilized the incidence was high and the mortality reminiscent of the Franco-Prussian War. When lines were stabilized, and medical service prompt and efficient, the incidence of tetanus dropped to 0.8 per thousand in the German forces and 0.2 per thousand in the United

[2] Dubovsky and Meyers, Jour. of Inf. Dis., 31:614, 1922.
[3] Editorial Comment, J. A. M. A., 110:15, 1183 (April 9) 1938.
[4] Sneath, Jour. R. A. M. C., 66:311, 1936.

States troops, with mortality in the United States cases as low as 11.1 percent.

In view of the results to be anticipated from active immunization against tetanus—namely, that the general use of this method would definitely prevent almost every case of tetanus—even the low rates for tetanus prevailing in the closing years of the World War are far too high.

Neither the location nor type of our future operations is known. Wherever they may be, delay in antitoxin administration would certainly cause increased tetanus. Such delay is favored by the speed and range of our air and surface scouting craft, the use of small groups of men in landing forces, and by the trends in aviation and in ground mechanization of troops; all of which are factors tending toward wide range of action and consequent separation from base medical attention.

The case for active immunization against tetanus with alum-precipitated tetanus toxoid (A. P. T. T.), as opposed to passive protection with antitoxic serum, rests upon the following:

OBSERVATIONS

A satisfactory degree of protective immunity against tetanus is provided by 2 injections of alum-precipitated tetanus toxoid (A. P. T. T.) 8 weeks apart. This immunity drops slowly but remains at protective levels for several years and with reimmunization for a lifetime.[5]

A. P. T. T., being serum-free, eliminates all possibility of allergic and serum reactions which are always a matter of concern and are often serious and perhaps, in a shocked wounded patient, fatal. The repeated use of tetanus antitoxic serum prophylactically is a menace in the allergic, and in the nonallergic ultimately builds up more or less serious sensitization to horse serum. This eventuality is particularly important, as such induced sensitization often seriously handicaps the use of therapeutic sera in other diseases.

Passive immunity due to an injection of serum falls steadily and rather rapidly after the third day and entirely disappears within 2 to 3 weeks. Thus, antitoxin does not protect in cases in which incubation is long; nor does it protect against the recrudescence of tetanus infection in war wounds, in operations or reamputations of limbs. Active immunization produced by alum-precipitated tetanus toxoid is continually present and constantly protects.

In persons with an established basic immunity, though it is low, a single stimulating or pick-up injection of A. P. T. T. raises immunity, in 7 days or less, to high levels, and in later weeks still higher.[6] Tet-

[5] Ramon, Presse Med., 44: 1625–1628 (October 17) 1936.

[6] Jones and Moss. Journ. Immunol., 30: 2, February 1936.

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anus toxin from a developing infection has been demonstrated to have the same stimulating effect.

Alum-precipitated tetanus toxoid, being thermostabile, can be stocked in the field where suitable refrigeration storage is not available. Antitoxin, on the other hand, is thermolabile, and under field conditions deteriorates, becoming progressively impotent or unreliable.

The advised procedure with A. P. T. T. is to give each immunized person, when wounded, a pick-up dose of toxoid, thus raising his blood antitoxin quickly and increasing his basic immunity for the future. Should the medical officer treating the case deem it advisable, both antitoxin and toxoid may be given at the same time but in opposite arms. One agent does not interfere with the action of the other.

Systemic reactions from the injection of alum-precipitated tetanus toxoid have been absent. Local reactions, at the point of injection, are usually mild and consist of slight pain and induration, due apparently to the alum in the toxoid suspension. In the series on the U. S. S. *Relief*, and in the large group recently titrated at the United States Naval Academy, not one man reported sick or missed formation. Ramon [5] states: "After having given thousands of injections of tetanus anatoxin (toxoid), the writer has still to see an untoward local or general reaction to speak of."

In a group at the Naval Academy, immunized since the series of titrations were completed, four men reported in with minor reactions necessitating a few days on the sick list. One of these having had a general reaction with malaise and fever up to 103° F. The other three men having had local reactions consisting of redness and swelling of the arm about the point of injection. As no such febrile reaction had occurred in several hundred previous injections, it was felt the possibility of some other etiology should be considered. It was presumed that these manifestations of local irritation resulted from shallow subcutaneous placement of the toxoid. The alum contained in the toxoid is probably the principal cause of the irritation. When more deeply placed, as in intramuscular injections, irritation is not so evident and the induration and soreness more transitory. Alum, with other simple chemical substances, shares the possibility of some individual idiosyncrasy.

The use of associated vaccines, or the combination of a number of antigenic substances, has been received with considerable enthusiasm in Europe; and the combination of diphtheria toxoid with tetanus toxoid, or with one or more bacterial vaccines, has been found to give excellent results. It appears that the response to each individual antigen is as great, or greater, when they are all used together as when used separately. In the United States the combination of

diphtheria and tetanus toxoid has yielded excellent results in the immunization of children. As diphtheria is not a problem among adults this combination for use in the Navy would not be as desirable as one of typhoid vaccine and alum-precipitated tetanus toxoid.

Work by Ramon,[5] McBryde,[7] Lincoln and Greenwald,[8] Sneath and Kerslake,[9] Ramon and Zoeller,[10] Bergey and Etris,[11] Sneath,[12] Hall,[13] Jones and Moss,[14] Gold,[15] and Sneath, Kerslake, and Scruby,[16] and others, has supplied documentary evidence of the satisfactory response in man and animals to active immunization with alum-precipitated tetanus toxoid. Horses and guinea pigs, both as susceptible to tetanus as is man, or more so, are protected by active immunization against an injection of tetanus spores even though the antitoxic levels are very low (0.01 to 0.001 unit) at the time.[16 17 18 19 20 21]

Since the adoption of active immunization with alum-precipitated tetanus toxoid in French cavalry horses, the previous constant incidence of tetanus has dropped to zero in the immunized animals, while maintaining its previous level in the unimmunized. Active immunization against tetanus by means of A. P. T. T. has recently (1936) been made universal in the French army.[5]

AUTHORS REPORT ON IMMUNIZATION

We present herewith a series of titrations on 152 midshipmen volunteers recently completed at the United States Naval Medical School in collaboration with the Medical Department, United States Naval Academy, Annapolis, Md. Interest in active immunization against tetanus at the Naval Academy was stimulated by Commander David O. Bowman (M. C.) United States Navy, medical officer in direct charge of medical activities in the athletic department at the Academy. Commander Bowman's desire to avoid serum reactions from prophylactic tetanus antitoxin, which had, on several occasions, caused loss of valuable football players from important games, prompted a consideration of active immunization with tetanus toxoid. All of the volunteers in group I are from the football squad.

[7] McBryde, So. Med. Jour., 30: 565–567 (June) 1937.
[8] Lincoln and Greenwald, Proc. Soc. Exp. Biol. and Med., 30: 1241 (June) 1933.
[9] Sneath and Kerslake, Canad. Med. Assn. Jour., 32: 132 (February) 1935.
[10] Ramon and Zoeller, Comptes, rend. soc. d. biol., 112: 347, 1933.
[11] Bergey and Etris, Jour. of Inf. Dis., 53: 331 (November and December) 1933.
[12] Sneath, J. A. M. A., 102: 1288 (April) 1934.
[13] Hall, Nav. Med. Bull., 35: 1 (January) 1937.
[14] Jones and Moss. Jour. Immunol., 33: 3; September 1937.
[15] Gold., J. A. M. A., 190: 481; August 1937.
[16] Sneath, Kerslake, and Scruby. Am. Jr. Hygiene, 25: 3; May 1937.
[17] Jones and Moss. Journ. Bact., 32: 1; July 1936.
[18] Van Wagoner. Military Surgeon, 81: 5; November 1937.
[19] Ramon and Lemetayer. Comptes, rend. soc. d. biol., 202: 1465; April 27, 1936.
[20] Bergey and Etris. Ann. Int. Med., 10· 11; May 1937.
[21] Cathala, J. Paris Medicale, 2: 355–361, November 6, 1937.

This series represents the largest number of titrations on persons actively immunized against tetanus which has been reported upon in the United States. This, together with the series reported by one of us (W. W. H.)[13] from the U. S. S. *Relief*, now brings the cases reported upon in the United States Navy to a total of 199 individuals.

The volunteers were divided into three groups. The 53 men in group I were given two injections of alum-precipitated tetanus toxoid, 0.5 cubic centimeter each, 8 weeks apart, as basic immunization. They were then given an injection of 0.5 cubic centimeter of A. P. T. T. 14 weeks later. Just before this stimulating or pick-up injection, blood was drawn for antitoxin titration (titration A), and 1 week afterward another titration was made (titration B). In titration A of this group, the lowest value obtained was less than 0.01 unit, and the highest 0.1 unit, with an average value for the group of 0.062 unit per cubic centimeter of blood serum. In the post-pick-up titration (titration B), the lowest value obtained was greater than 0.075 but less than 0.1 unit, and the highest value was greater than 1.0 but less than 1.5 units, with an average for the group of 0.433 unit per cubic centimeter of blood serum.

The 77 men in group II were given two injections of A. P. T. T., 0.5 cubic centimeter each, 8 weeks apart, as basic immunization. They were then given an injection of 1.0 cubic centimeter of A. P. T. T. 19 weeks later. Just before this stimulating or pick-up injection, blood was drawn for antitoxin titration (titration A), and 1 week afterward another titration was made (titration B). It titration A of group II the lowest value obtained was 0.01 unit and the highest was greater than 0.1 but less than 0.15 with an average of 0.055 unit per cubic centimeter of serum. In the post pick-up titration (titration B) of group II the lowest value was 0.1 unit; the highest was greater than 2.0 but less than 2.5 with an average of 0.684 unit per cubic centimeter of serum.

The 22 men in group III were given two injections of alum-precipitated tetanus toxoid, 1.0 cubic centimeter each, 6 weeks apart, as basic immunization. They were then given an injection of 1.0 cubic centimeter of A. P. T. T. 14 weeks later. Just before this stimulating or pick-up injection, blood was drawn for antitoxin titration (titration A). Only 13 of the 22 subjects were available for this bleeding and titration. One week afterward another titration was made (titration B). In titration A of this group, the lowest value obtained was 0.05 unit, and the highest 0.5 unit, with an average for the group of 0.14 unit per cubic centimeter of blood serum. In the post-pick-up titration (titration B), the lowest value obtained was 0.1

unit, and the highest value 1.5 units, with an average for the group of 0.552 unit per cubic centimeter of blood serum.

To appreciate the really considerable amount of antitoxin these figures represent, it must be realized that tetanus antitoxin is measured in units, each of which equals a quantity of antitoxin sufficient to neutralize approximately 1,000 minimal lethal doses (guinea pig) of toxin. For example, 1 cubic centimeter of serum containing one-tenth of a unit of antitoxin contains the amount necessary to protect a guinea pig against 100 minimal lethal doses of toxin. An M. L. D. is that amount of toxin which will kill a 350-gram guinea pig in just 96 hours. To calculate the total amount of antitoxin in an individual's body, one simply multiplies the titre of 1 cubic centimeter by the total volume of serum which is approximately one-half of the blood volume. Thus, a 70-kilogram man, having in his body approximately 2,700 cubic centimeters of serum, and having at the moment only 0.5 unit of antitoxin per cubic centimeter, would have current in his blood stream 1,350 units of antitoxin. The important point, of course, is that in addition to the amount his spot titration represents, he is at any time capable of producing more antitoxin when stimulated by toxoid or by actual toxin from a tetanus infection.

Titration of antitoxic potency of each serum sample was carried out according to the standard method prescribed by the National Institute of Health, Washington, D. C.

The product used in this series was Lilly's alum-precipitated tetanus toxoid (lots number 928849 and 933313) prepared according to the requirements of the National Institute of Health for a dose of 0.5 cubic centimeter. The minimum requirements for tetanus toxoid, as defined by the National Institute of Health, file No. B–2207, January 17, 1938, are:

1. The statement "No U. S. Standard of Potency" should not appear on the label.
2. Horse meat shall not be used in preparing the broth from which the original tetanus toxoid is made.
3. Tetanus cultures for the production of toxin shall be incubated for not longer than 14 days.
4. The original toxin from which tetanus toxoid is made shall have a test dose of not more than 0.01 cubic centimeter or an M. L. D. for the guinea pig of not more than 0.0001 cubic centimeter.
5. Formalin used for detoxification shall conform to the requirements of the United States Pharmacopoeia and the smallest amount which will bring about complete detoxification shall be used, not exceeding 0.4 percent.
6. Tests demonstrating detoxification shall be done as follows:

Five cubic centimeters of crude toxoid given subcutaneously in guinea pigs weighing 300 grams shall cause no signs of spastic paralysis at any time during a period of 21 days. A sufficient number of test animals shall be injected to insure not less than four shall complete a given test.

7. Minium antigenic requirements for crude tetanus toxoid shall be as follows: At least 10 guinea pigs weighing 300–400 grams shall receive, subcutaneously, the initial human dose of crude toxoid. At the expiration of 6 weeks each of these guinea pigs shall be injected with 10 M. L. D.'s of a stable tetanus toxin, the toxicity of which shall be shown at the same time by injection of 1 M. L. D. of toxin into normal guinea pigs weighing 350 grams. Eighty percent of the test animals shall show no signs of spastic paralysis for a period of 10 days.

8. Protocols of preliminary toxicity, antigenic and safety tests on each lot of crude toxoid intended for distribution shall be submitted to the National Institute of Health with 100 cubic centimeters of the final product and the lot held until released by report from the National Institute of Healtn.

The minimum requirements for alum-precipitated tetanus toxoid, as defined by the National Institute of Health are:

1. Alum-precipitated tetanus toxoid shall bear the designation "Alum Precipitated" on the labels of the finished package.

2. Alum-precipitated tetanus toxoid shall be prepared only from crude toxoid meeting the requirements stated in Nos. 2, 3, 4, 5, and 6 above and in addition shall meet the following antigenic requirements:

The human dose when administered subcutaneously to guinea pigs weighing 500 grams shall produce at least two units of antitoxin per cubic centimeter of blood serum in not more than 6 weeks. At least four guinea pigs shall be used for this test. Aliquot parts of the blood serum from all guinea pigs may be pooled for the test for antitoxic content.

3. Alum used for precipitation shall comply with the requirements of the United States Pharmacopoeia and the finished product shall contain not more than 20 milligrams of alum per human dose, the calculation being based on the total amount of alum added for precipitation.

4. For each lot of alum-precipitated toxoid protocols showing detoxification as outlined in No. 6 above, and antigenicity as outlined here in No. 2 shall be submitted to the National Institute of Health with 50 cubic centimeters of the final product, and the lot held until released for distribution by report from the National Institute of Health.

5. Phenoloid preservative shall not be used in tetanus toxoid.

6. The maximum human dose of tetanus toxoid shall not exceed one cubic centimeter.

7. The final container of alum-precipitated toxoid shall contain not more than 10 human doses.

The dose of 0.5 cubic centimeter was doubled for the third injection in group II and for all three injections in group III. Though this increased dosage did produce definitely increased antitoxin responses, as noted above, and in the tables of titrations, these increased amounts of toxoid did not produce proportionate increases in antitoxin response within a week. It is probable that at a later interval, such as 4 to 8 weeks, the steadily rising titre[14] would have mirrored the increased antigenic stimulation. The few local reactions noted above were

probably intensified by the increased amount of alum in these 1.0 cubic centimeter doses. Alum is limited by the National Institute of Health requirements to a maximum of 20 milligrams per human dose. These doses contained alum approximating this amount.

No individual in this series failed to respond adequately to antigenic stimulation by A. P. T. T. It may be noted here that the literature so far contains no report of any person who has been found refractory to immunization against tetanus.

Standard toxin and antitoxin used in this study were supplied by the National Institute of Health.

We wish to here acknowledge the valued technical assistance of Pharmacist C. C. Fowkes, U. S. Navy.

TABLE I.—*Group I—53 subjects*

[Units of antitoxin per cc of blood serum]

No.	Titration A	Titration B	No.	Titration A	Titration B
I-1	>0.025-<0.05	0.1	I-29	.025	.1
I-2	----------	.1	I-30	>.075- <.1	.25
I-3	>.1 - <.15	.75	I-31	.025	.1
I-4	>.025- <.05	.1	I-32	>.1 - <.15	.25
I-5	>.075- <.1	.1	I-33	>.1 - <.15	>1.0 -<1.5
I-6	>.075- <.1	>.75 -<1.0	I-34	.025	>.075- <.1
I-7	>.075- <.1	.1	I-35	.025	.1
I-8	>.025- <.05	>.075- <.1	I-36	.1	.5
I-9	>.05 - <.075	.25	I-37	.075	.25
I-10	.025	.1	I-38	>.1 - <.15	.5
I-11	>.075- <.1	>1.0 -<1.5	I-39	.075	.25
I-12	<.01	>.075- <.1	I-40	>.1 - <.15	.75
I-13	>.1 - <.15	>.25 - <.5	I-41	>.1 - <.15	.75
I-14	.025	.25	I-42	.075	.25
I-15	.025	.1	I-43	.075	.75
I-16	.025	>.1 - <.25	I-44	.1	>1.0 -<1.5
I-17	>.05 - <.075	2.0	I-45	.025	.1
I-18	.05	>.1 - <.25	I-46	.1	.5
I-19	>.01 - <.025	.1	I-47	.025	>.075- <.1
I-20	>.075- <.1	>1.0 -<1.5	I-48	.075	.1
I-21	.025	.1	I-49	.1	.5
I-22	.05	.5	I-50	.075	>.25 - <.5
I-23	.075	>.5 - <.75	I-51	.05	.5
I-24	.05	.1	I-52	.025	>.75 -<1.0
I-25	>.1 - <.15	>.25 - <.5	I-53	>.1 - <.15	>1.0 -<1.5
I-26	<.01	>.075- <.1			
I-27	.075	>.5 - <.75	Average	.062	.433
I-28	.025	.5			

NOTE.—The sign (>) means greater than; and the sign (<) means less than.

The 53 men in group I were given two injections of alum-precipitated tetanus toxoid, 0.5 cubic centimeter each, 8 weeks apart, as basic immunization. They were then given an injection of 0.5 cubic centimeter of A. P. T. T. 14 weeks later. Just before this stimulating or pick-up injection, blood was drawn for antitoxin titration (titration A), and 1 week afterward another titration was made (titration B).

TABLE II.—*Group II—77 subjects*

[Units of antitoxin per cc of blood serum]

No.	Titration A	Titration B	No.	Titration A	Titration B
II-54	0.025	0.25	II-94	.01	.5
II-55	.075	1.0	II-95	.025	.25
II-56	.05	.25	II-96	.1	>1.0 -<1.5
II-57	>.05 -<.075	.75	II-97	.05	.1
II-58	.05	.75	II-98	>.05 -<.075	.5
II-59	>.05 -<.075	.5	II-99	.025	.5
II-60	.05	.75	II-100	.075	.75
II-61	.025	>.75 -<1.0	II-101	>.1 -<.15	.25
II-62	.05	.5	II-102	.05	.5
II-63	.05	.25	II-103	.1	>2.0 -<2.5
II-64	.025	1.0	II-104	<.01	.1
II-65	.05	.5	II-105	>.1 -<.15	1.0
II-66	>.075-<.1	1.0	II-106	.05	1.0
II-67	.025	.25	II-107	.05	.5
II-68	>.1 -<.15	>2.0 -<2.5	II-108	.075	1.0
II-69	>.1 -<.15	>1.0 -<1.5	II-109	.05	.25
II-70	<.01	.1	II-110	.1	.25
II-71	>.025-<.05	.25	II-111	.05	.1
II-72	>.1 -<.15	1.0	II-112	.01	.25
II-73	>.025-<.05	1.5	II-113	>.025-<.05	>.25 - <.5
II-74	.1	1.0	II-114	>.05 -<.075	1.0
II-75	.01	.25	II-115	.1	.5
II-76	.01	.25	II-116	.1	1.0
II-77	.025	.5	II-117	.075	.25
II-78	>.05 -<.075	>2.0 -<2.5	II-118	.075	.75
II-79	>.01 -<.025	.1	II-119	.05	.25
II-80	.075	.5	II-120	.025	.75
II-81	.01	.5	II-121	.05	.75
II-82	.025	>1.0 -<1.5	II-122	.025	>.075- <.1
II-83	>.025-<.05	>.075- <.1	II-123	>.1 -<.15	1.0
II-84	.1	>2.0 -<2.5	II-124	.01	.25
II-85	>.1 -<.15	>2.0 -<2.5	II-125	.05	.75
II-86	.05	1.5	II-126	.025	.25
II-87	.075	>2.0 -<2.5	II-127	.05	>.25 - <.5
II-88	.025	.25	II-128	.025	.5
II-89	.05	.75	II-129	.1	1.0
II-90	.025	1.0	II-130	.01	.25
II-91	.1	1.5			
II-92	.1	.5	Average	.055	.684
II-93	.025	.1			

The 77 men in group II were given two injections of alum-precipitated tetanus toxoid, 0.5 cubic centimeter each, 8 weeks apart, as basic immunization. They were then given an injection of 1.0 cubic centimeter of A. P. T. T. 19 weeks later. Just before this stimulating or pick-up injection, blood was drawn for antitoxin titration (titration A), and 1 week afterward another titration was made (titration B).

TABLE III.—*Group III—22 subjects*

[Units of antitoxin per c. c. of blood serum]

No.	Titration A	Titration B	No.	Titration A	Titration B
III-131	----------	0.1	III-144	----------	>.1-<.5
III-132	----------	>.1-<0.5	III-145	.5	----------
III-133	>0.05-<0.1	>.1-<.5	III-146	.05	<.5
III-134	----------	.5	III-147	----------	1.5
III-135	>.1-<.25	1.0	III-148	.25	.5
III-136	----------	.1	III-149	.1	>.5-<1.0
III-137	<.05	.5	III-150	>.05-<.1	.5
III-138	.1	<.5	III-151	.25	.5
III-139	----------	.1	III-152	.05	.5
III-140	>.05-<.1	1.0	III-153	----------	1.5
III-141	----------	>.5-<1.0			
III-143	.1	1.0	Average	.140	.552

The 22 men in group III were given two injections of alum-precipitated tetanus toxoid, 1.0 cubic centimeters each, 6 weeks apart, as basic immunization. They were then given an injection of 1.0 cubic centimeter of A. P. T. T. 14 weeks later. Just before this stimulating or pick-up injection, blood was drawn for antitoxin titration (titration A). Only 13 of the 22 subjects were available for this bleeding and titration. One week afterward another titration was made (titration B).

SUMMARY

1. Alum-precipitated tetanus toxoid (A. P. T. T.) has been repeatedly demonstrated to be a reliable and satisfactory agent for the production of active immunity against tetanus. The degree of this immunity drops slowly but remains at protective levels for several years and, with reimmunization, for a lifetime.

2. Prophylactic antitetanic serum affords temporary passive immunity. It is effective only when given promptly. Its protection disappears rapidly and is entirely gone in 2 to 3 weeks. Thus, a prolonged incubation period or recrudescence of an infection may result in clinical tetanus when single injections of serum are depended upon.

3. Alum-precipitated tetanus toxoid is thermostabile and can be carried in the field without refrigeration. This is not the case with thermolabile antitoxic serum.

4. Active immunity against tetanus is peculiarly fitted to the conditions of modern warfare in which the speed and range of modern operations tend to constantly separate personnel from base medical attention.

5. Accumulation of data now justifies the conclusion that such induced immunity can be safely relied upon to protect against tetanus and that this disease, with its high mortality rate, may be practically eliminated from the hazards of warfare.

6. Alum-precipitated tetanus toxoid is serum-free and thus avoids the allergic reactions and serum sickness incident to passive immunization with tetanus antitoxin.

7. Reactions, local or general, with alum-precipitated tetanus toxoid are rare and when they do occur are minimal. Irritation caused by alum, an integral part of alum-precipitated toxoid, is the principal cause of the mild local reactions.

8. A report of titrations on 152 United States Naval Academy volunteers is given. Each man received three injections of alum-precipitated tetanus toxoid, two as basic immunization and a third as a stimulating or pick-up injection. Titrations of serum antitoxin were made before and after the final toxoid stimulation.

9. A satisfactory response was obtained in all individuals.

10. This series brings the total immunized, titrated, and reported from United States Navy personnel to 199.

MENTAL DISEASES IN THE UNITED STATES NAVY

A COMPARATIVE ANALYSIS OF THE INCIDENCE

By Commander F. L. McDaniel, Medical Corps, United States Navy

Not long ago the question was officially discussed by the Navy Department as to whether or not there has been an unusual increase of patients suffering from mental diseases in the naval service. For several years the opinion has been generally held by naval officers that disabilities resulting from mental disorders are definitely on the increase in the Navy. Several months ago the matter was made the subject of correspondence between the Chief of the Bureau of Navigation and the Chief of the Bureau of Medicine and Surgery, and to quote, "the Chief of the Bureau (Navigation) requests that an analysis of the situation be made to determine the causes or reasons for what appears to be an unusual increase of patients suffering from mental diseases."

Among others, this writer was requested to express his opinion upon the subject. In order to make an intelligent estimate of the situation concerning mental diseases in the Navy the writer believed that it would be well to make a statistical comparison, so far as the data might be available, with the admission rate in the United States Army and also for the population as a whole in the continental United States.

In order to determine whether there has been any definite trend in the rates of admissions for mental diseases in the Navy, the Division of Preventive Medicine, Bureau of Medicine and Surgery, furnished the following admission rates compiled from Bureau statistics:

Admissions for mental diseases, U. S. Navy

Year	Average strength	Admissions	Rate per 100,000	Year	Average strength	Admissions	Rate per 100,000
1926	113,756	435	382	1932	110,717	244	220
1927	115,316	394	342	1933	108,183	264	244
1928	116,047	367	316	1934	109,383	246	225
1929	117,388	302	257	1935	114,188	256	224
1930	117,453	325	277	1936	124,408	271	218
1931	112,767	247	219				

It will be noted from the above that we have a range of 11 years covering the annual admissions for diseases of the mind. This table shows that from 1926 to 1929, inclusive, there was a gradual decline in the rate of admissions to the sick list for mental diseases. For the calendar year 1930 there was a moderate increase in the admissions per 100,000. This may be accounted for by the fact that the beginning of the financial depression drove many misfit, psychopathic, and maladjusted individuals to seek refuge in the military service. During the calendar year 1931 there was a rather sharp

drop in the admission rate. It was during this period, it will be recalled, that the Navy adopted a more intensive policy of selective recruiting. The various recruiting stations were deluged with applicants for enlistment and long waiting lists were maintained. As the result of this, the applicants for enlistment were more thoroughly investigated and the psychopaths and incipient psychotics eliminated themselves automatically while on the waiting list. In referring to chart (fig. 14), it will be noted that since 1931 there has been very little variation in the admission rate, except that in the years 1935 and 1936 there was a slight downward trend.

In studying the reports of the Surgeon General of the United States Army, it is noticed that the groupings do not correspond exactly with similar groupings in the report of the Surgeon General of the Navy. The Division of Preventive Medicine, Bureau of Medicine and Surgery, has regrouped this list in order to make a relative comparison with our figures. Below is a table showing the admission rate per 100,000 for mental diseases in the United States Army, covering a period of 1926–35, inclusive:

Admissions for mental diseases, U. S. Army

Year	Average strength	Admissions	Rate per 100,000	Year	Average strength	Admissions	Rate per 100,000
1926	133, 148	1, 216	913	1931	136, 321	1, 094	803
1927	133, 702	1, 369	1, 024	1932	132, 736	904	681
1928	135, 179	1, 331	985	1933	137, 188	834	608
1929	136, 905	1, 359	993	1934	135, 320	1, 000	739
1930	138, 212	1, 222	884	1935	143, 158	1, 091	762

This table shows a relatively high admission rate occurring in 1927, and since that year there has been a gradual and steady decline in the admission rate for mental diseases in the Army up to and including the year 1933. Since 1933 and through the statistics for the year 1935, a rise in the admission rate is shown.

In a personal interview with Dr. Truesdell, Chief Statistician for Population, Bureau of the Census, the following information was obtained regarding the admission rate per 100,000 for mental diseases in the United States. These figures are based upon admissions to State hospitals only and are as follows:

Admissions for mental diseases in the United States

[State hospitals only. Rate per 100,000]

Year:	Rate	Year:	Rate
1926	46. 2	1931	49. 7
1927	47. 5	1932	49. 0
1928	49. 6	1933	56. 5
1929	49. 8	1934	55. 2
1930	51. 1	1935	56. 8

The first point noted is that the admission rate to State hospitals for the population at large is very much less than the admission rate for the Navy or the Army. There are, however, many factors to be taken into consideration in making a comparison of this kind. Dr. Truesdell states: "It should be clearly recognized that statistics of mental patients in hospitals do not directly measure the prevalence of mental disease, either in the country as a whole or in the various States. Many persons having nervous and mental diseases never receive hospital treatment. The hospital cases probably cover the most severe type of mental diseases, but fail to cover many cases of a milder type." Another consideration in making a comparison between the military services and the population at large of admission rates in this group of patients, is the fact that the incidence of mental diseases in men is about 33 percent more than in women. Also, mental disease is quite rare in childhood. Available statistics indicate that mental disease is proably on the increase in the population as a whole. Figures given above show a gradual increase in the rate of first admissions to State hospitals since 1926.

I have compiled figures to show the total number of Navy and Marine Corps patients admitted to St. Elizabeths Hospital annually. The figures from 1927 to 1936 inclusive may be tabulated as follows:

Total number of Navy and Marine Corps patients admitted to St. Elizabeths Hospital 1927–36, inclusive

Year:	Number	Year:	Number
1927	120	1932	101
1928	134	1933	107
1929	137	1934	104
1930	163	1935	84
1931	123	1936	123

In the Navy, under our classification of diseases of the mind, we include all cases of mild psychoneuroses, psychopathic states, etc., with the major psychoses. It is our policy in the Navy to transfer to St. Elizabeths Hospital only those patients whose condition is serious enough to require prolonged hospitalization prior to final disposition. Patients suffering from the milder mental conditions are either returned to duty after treatment or are surveyed with a recommendation that they be discharged from the naval service. Consequently there is bound to occur a considerable spread between the number of cases admitted to the sick list and the number of patients eventually transferred to St. Elizabeths Hospital. It is obvious that this ratio of patients admitted to the sick list to the patients transferred to St. Elizabeths Hospital will vary considerably from time to time. In the composite chart (fig. 14), it will be noted that this ratio does vary to a considerable degree from year to year. The following table shows

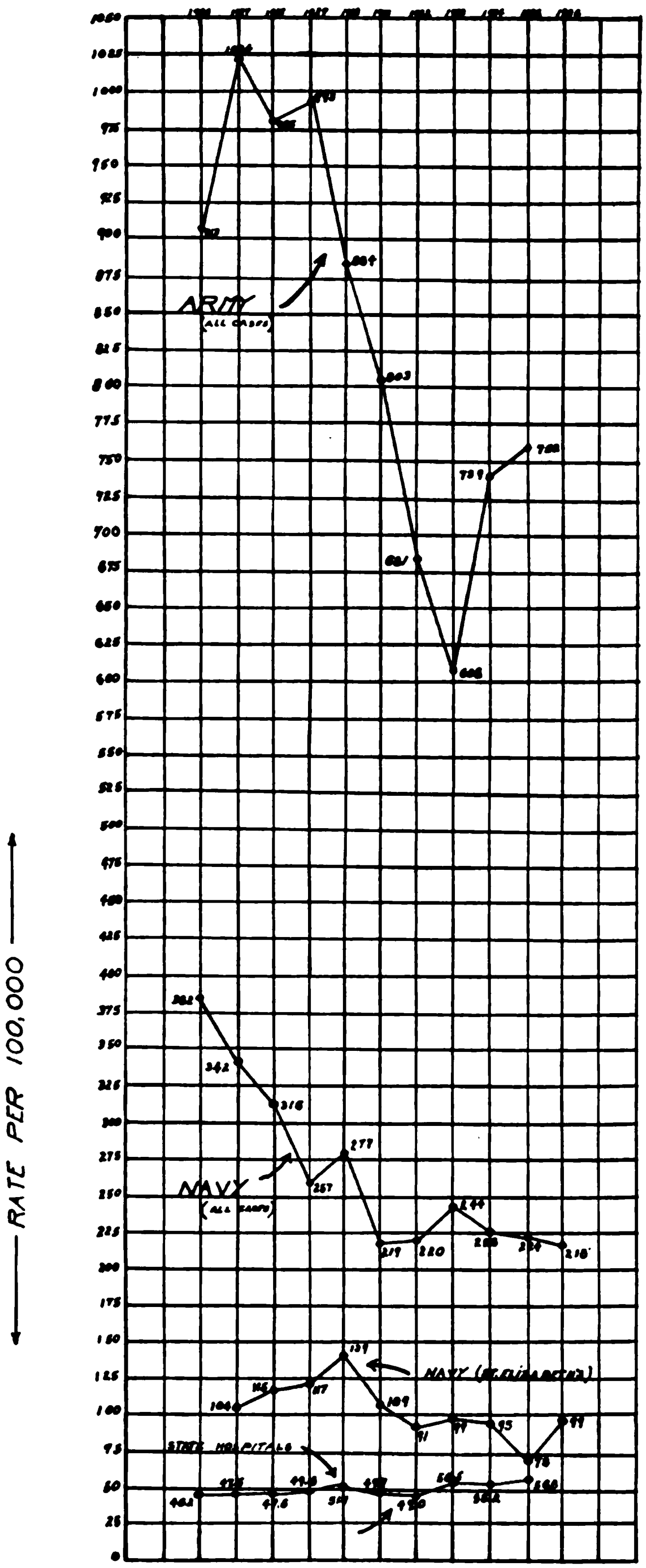

FIGURE 14

the percentage of mental cases transferred to St. Elizabeths Hospital based on the annular number of admissions for mental diseases, United States Navy, for the period 1927–36:

Year	Annual number admissions, mental diseases, U. S. Navy, all cases	Annual number patients admitted to St. Elizabeths Hospital	Percentage of mental cases transferred to St. Elizabeths	Year	Annual number admissions, mental diseases, U. S. Navy, all cases	Annual number patients admitted to St. Elizabeths Hospital	Percentage of mental cases transferred to St. Elizabeths
1927	394	120	30.5	1932	244	101	41.4
1928	367	134	36.5	1933	264	107	40.5
1929	302	137	45.3	1934	246	104	42.3
1930	325	163	50.2	1935	256	84	32.8
1931	247	123	49.8	1936	271	123	45.4

As shown above, an average of 41.47 percent of all patients admitted to the sick list with a mental disease have been transferred to St. Elizabeths yearly for the past 10 years. A glance at the table will show a variation from 30.5 in 1927 to a high of 50.2 in 1930. For some reason a small percentage of patients, 32.8 percent, were transferred to St. Elizabeths in 1935 although the total number of admissions for mental diseases for the Navy that year were close to the average since 1931. Reference to chart (fig. 14) shows an average of 104.1 patients per 100,000 transferred to St. Elizabeths annually for the past 10 years.

From a study of available statistics it appears that there is a gradual increase in the incidence of mental disease among the population at large. This opinion seems to be quite generally held but whether this increase is more apparent than real is a mooted question. In the composite chart the figures covering the population at large are based on State hospital admissions only. The admissions for mental diseases in the Army indicates that the trend has been upward since 1933 and that this upward trend was preceded by a downward trend from 1927. In glancing at the statistics for the Navy, an 11-year period 1926–36, inclusive, we note that there was, from 1926 through 1929, a steady decline in the admissions for mental disease. There was a moderate increase during 1930 and a sharp decline in 1931, followed by a leveling-off trend which has tended downward for the past 2 years. Explanation has already been offered for this. The annual number of admissions for Navy patients to St. Elizabeths Hospital showed a gradual decline from 1930 through 1935. During 1936 there was a moderate increase in the rate of admissions to St. Elizabeths. As mentioned before, it will be noted that the percentage of mental cases transferred to St. Elizabeths compared to the total number of admissions for mental diseases in the United States Navy will show considerable variation. For instance, in 1935 only 32.8

percent of all patients admitted to the sick list with a mental diagnosis were eventually transferred to St. Elizabeths Hospital. In 1936 we find that 45.4 percent of patients admitted were eventually transferred to that institution. It would require a great deal of study, research, and examination of all individual records to enable one to offer an explanation as to the reason for this percentage variation in transfers to St. Elizabeths. It obviously means that during certain years there occurred a greater percentage of serious mental cases among the total admissions for mental disease. It will be noted however, that during 1936 the percentage was only 4 points above the average for the past 10 years. All in all it is apparent that there are considerable swings in the percentage of patients transferred to St. Elizabeths compared to the total admissions to the sick list in the Navy, and deductions based on these figures cannot be made at the present time.

Although the statistics show that there is a definite downward trend in the rate of admissions for mental diseases in the United States Navy it can be still further accelerated by observing increased vigilance in our recruiting examinations. It has been thoroughly demonstrated that selective recruiting, and especially a thorough investigation of each individual recruit, can serve in a large measure to weed out many of our potential mental patients. It may be impossible at times to detect the existence of potential mental disease in a recruit during the course of a routine examination. A study of his past history, however, particularly concerning his social relationships, school history, and occupational adjustment, will throw a great deal of light upon the individual recruit's psychological make-up and potential trends. It would appear that the Navy is now maintaining an excellent record so far as its admissions for mental disease is concerned when this is compared with other figures.

Regarding transfers of our psychotic patients to St. Elizabeths Hospital, I believe that our percentage of admissions to St. Elizabeths Hospital will be decreased when more use is made in our naval hospitals of the modern methods for treating the two largest groups of psychoses we have, that is, general paresis and dementia praecox.

The successful treatment of syphilitic meningo-encephalitis (general paresis) has shown such favorable response to fever therapy and the treatment of dementia praecox by hypoglycemic shock has met with such success, that if we continue to avail ourselves of these and other therapeutic procedures, we may be able to discharge many cases to civilian life which would otherwise be eventually transferred to St. Elizabeths Hospital.

Among both medical and line officers there is a commonly held belief that the tendency to break down on the part of individuals inherently weak or potentially abnormal mentally is on the increase inasmuch as the Navy personnel has probably been subjected to

more intensive stress and strain in the past few years due to unsettled world conditions, more intensive training and drill, increased competition and tension of officer personnel as the result of the present system of promotion. While the writer thoroughly agrees that increased stress and tension, worry over promotion, etc., may be precipitating factors in individuals predisposed to mental breakdowns, he does not believe by any means that it plays a major part in our causes for admissions for mental diseases. Be this as it may, the figures show that there has been a decrease in the incidence of mental diseases in the Navy and that the trend is still downward. Attention may again be called to these two salient points: First, The average yearly rate per 100,000 of admissions to the sick list for mental diseases 1926–36 inclusive, is 266. The yearly rate has been below this average since 1930. Also, the average yearly rate per 100,000 of mental patients eventually transferred to St. Elizabeths Hospital, 1927–36, inclusive, is 104. The yearly rate has been below this average since 1931.

PHYSIOLOGIC STUDIES OF HELIUM [1]

By Lieutenant A. R. BEHNKE, Medical Corps, United States Navy; and Lieutenant O. D. YARBROUGH, Medical Corps, United States Navy.

INTRODUCTION

Twenty years ago the cost of helium [2] was of the order of $2,500 per cubic foot. Its present volume production at a cost of 1 cent per cubic foot has made it available for the flotation of airships, for use in medical treatment, and for the prevention and treatment of compressed-air illness.

In medicine Barach [3] began the study of the therapeutic use of helium particularly in the treatment of asthma and obstructive lesions of the larynx. More recently Eversole [4] tested its value in the field of inhalation anesthesia. The essential property making helium of value in these treatments is its decreased density compared with air.

In diving operations Sayers and Yant [5] suggested the breathing of helium because of its decreased solubility and more rapid diffusion rate. They showed that animals could be decompressed more rapidly

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[1] From the Experimental Diving Unit, Navy Yard, Washington, D. C. Submitted for publication, July 18, 1938.

The authors desire to express their appreciation to Lieutenant Commander C. B. Momsen, United States Navy, for many valuable suggestions, and to members of the Bureau of Construction and Repair for the splendid support that they have given to these investigations.

The technical work of L. B. Lewis, pharmacist's mate, first class; T. Merritt, pharmacist's mate, first class; and H. H. Snider, pharmacist's mate; third class; was especially commendable.

[2] Information Circular about Helium. U. S. Bureau Mines Information Circular 6745, 1933.

[3] Barach, A. L. The Therapeutic Use of Helium. J. A. M. A., 107: 1273 (October 17, 1936).

[4] Eversole, U. H. Use of Helium in Anesthesia. J. A. M. A., 110: 878 (March 19, 1938).

[5] Sayers, R. R., and Yant, W. P. Value of Helium Oxygen Atmosphere in Diving and Caisson Operations. Anesth. and Anal., 5: 127 (June 1926).

in a $He-O_2$ atmosphere than in air. End[6] recently has experimented with helium in diving tests and his results are promising.

Some important properties of helium are its inactivity, since no compounds of helium are known to exist; its decreased density, one-seventh that of nitrogen; its rapid diffusion rate, twice that of nitrogen; and its extremely low liquefying temperature, −267.9° C., or about 5.2° C. above absolute zero. In the following series of physiologic studies additional facts will be presented as they developed during an investigation connected with the use of helium in diving tests in depths up to 500 feet carried out at this diving unit under the supervision of Lieutenant Commander Momsen, United States Navy.

I. RELEVANT OBSERVATIONS OF THE EFFECTS OF HELIUM ON THE HUMAN BODY

In the course of any extensive work with helium, investigators have invariably noticed several peculiar effects of this gas on the body. First among these effects is the change in voice. The laryngeal muscles controlling as they do the tension of the vocal cords are trained from childhood to produce different tones. This muscular training, however, is accomplished in an air medium, the density of which is considerably greater than that of helium. Therefore, when an individual is breathing helium and attempts to talk the muscles respond as they normally do in air. The resulting sound is higher in pitch and nasal in quality compared with sound emitted when air is breathed. It is interesting to note that divers who have repeatedly breathed helium mixtures have overcome these voice phenomena somewhat so that the voice tone approaches normal.

Second among the bodily effects is a certain degree of chilling during the exposure to helium mixtures. This chilling was more noticeable during suit diving when in the water, although a lesser degree occurred during simple breathing under pressure in a dry chamber. It was thought that this chilling possibly might affect the required decompression time by slowing the circulation particularly in the skin area. Measures have been taken to warm the body during helium breathing, but there has not been sufficient time or experimentation to determine the effect on gas uptake, or gas elimination, from the body.

With regard to bubble formation following exposure to high pressures it was reasonable to believe that gas emboli might form following helium breathing in a manner similar to their formation in an air atmosphere, if sufficient reduction in decompression time were made.

[6] End, E. Rapid Decompression Following Inhalation of Helium-Oxygen Mixtures Under Pressure. Amer. Jour. Physiol., 120: 712 (December 1937).

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This belief was substantiated by the occurrence of bends[7] while breathing or following the respiration of helium-oxygen mixtures. Certain differences, however, in the aspects of the cases of bends have been noted.

Preeminently there has been an absence of grave symptoms in a large number of cases. That is to say, symptoms such as unconsciousness and paralysis have not occurred. By contrast such mild symptoms as itching and skin rash have prevailed, frequently without sequellae. The occurrence of pain in about one-third of the cases has been promptly relieved by recompression and oxygen treatment.

To account for the absence of grave symptoms it should be noted that immediate treatment undoubtedly was an important factor, but, in addition, the low fat-water solubility ratio of helium compared with nitrogen is also an important consideration. Grave symptoms are usually produced when nervous tissue is the site of bubble formation. Such tissue having a high percentage of fat should absorb considerably less helium than nitrogen. Bearing in mind the low fat-water solubility ratio of helium, we have postulated further that in diving operations employing helium the important or controlling tissues concerned in decompression are those which are relatively rapid (tissues largely fluid) with regard to saturation or desaturation, whereas with nitrogen, the relatively slow or fatty tissues are all important. This theory gleaned from the laboratory has been one of the fundamentals in formulating decompression tables for use with helium.

In connection with the treatment of bends it has been frequently observed that the bends respond more quickly to recompression and usually require less pressure for relief of symptoms than is required for the treatment of nitrogen bends.

Of all the bodily effects of helium the most striking is the feeling of normality, in contrast with the usual intoxication and sense of pressure and depth associated with high air pressures. This improved mental condition of the diver has supplanted the saving in decompression time as the most important expected advantage in using helium.

II. SOLUBILITY OF HELIUM IN WATER AND OLIVE OIL COMPARED WITH NITROGEN

The body solvents for inhaled gases are hemoglobin, fluids, and fat. Determinations of the solubility of helium in fat are of importance, therefore, in estimating the time necessary for the body to come into equilibrium with a constant helium tension in the lungs.

[7] The term, "bends," usually refers to those symptoms of compressed-air illness characterized by pains in and around the joints. In this paper the term, "bends," will be used because of simplicity to include all symptoms (predominantly pain) arising from gas emboli, whether of helium or nitrogen origin, following decompression from high pressure atmospheres.

Since Campbell [8] has shown that the constituents of body fat, namely stearin, palmitin, and olein dissolve about the same amount of nitrogen per hundred cubic centimeters of substance as does bone marrow (90 percent fat), or about 5 cubic centimeters of nitrogen per 100 cubic centimeters when saturated with air at 38° C., and approximately 6.6 cubic centimeters when the nitrogen tension is corrected to 760 millimeters; determinations of the solubility of helium in olive oil containing about 72 percent olein and 28 percent palmitin should give an accurate estimate of the solubility of helium in body fat.

Experimental Method

Olive oil, U. S. P.[9], was equilibrated at a temperature of 38° by bubbling through the oil pure nitrogen or helium (97.65 percent) previously dried and freed from traces of carbon dioxide and oxygen by passage through sulphuric and pyrogallic acids for periods up to 1½ hours.

The inert gas was then extracted in vacuo by repeated shaking in the Van Slyke apparatus.

The solubility of helium and nitrogen in water was determined under the same conditions except that the respective gases were passed through water in place of sulphuric acid before admission to the tonometer tube. The type of analytic procedure employed in these determinations was similar to that developed by Van Slyke and his co-workers.[10]

Calculations

The volume percent of gas in the analyzed solutions was calculated by means of equations formulated by Van Slyke and Stadie [11] for reducing the pressure of a gas extracted in vacuo to standard conditions of temperature and pressure.

For water, the calculation simplified itself to—

$$\text{Vol. percent gas} = P \times N_2 \text{ factor}$$

For oil, i, the reabsorption coefficient, and α', the Ostwald distribution coefficient of a gas between gaseous and liquid phases, in the equation of Van Slyke and Stadie were omitted in the calculations since repeated gas extractions undoubtedly reduced these factors to a negligible minimum.

The helium in flasks was found by analysis to be 97.65 percent pure. The residual gas was assumed to be nitrogen, and the necessary corrections were made in the calculations.

Discussion of Experimental Results

The analytical data are enumerated in table 1. The solubility coefficient, α, represents the cubic centimeter of gas (0°, 760 mm.) dissolved per cubic centimeter of liquid.

In the water analyses the greatest difference between the highest and lowest values was 0.01 volumes percent, while in the oil analyses the greatest difference was 0.036 volumes percent.

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[8] Campbell, J. A. and Hill, L. Quart. Journ. Exp. Physiol., 23: 197 (1933).

[9] Analyzed through the courtesy of Mr. Gault at the U. S. Naval Medial Center, Washington, D. C.

[10] Van Slyke, D. D., Dillon, R. T., and Margaria, R. Journ. Biol. Chem. 105: 571 (1934).

[11] Van Slyke, D. D., and Stadie, W. C. Journ. Biol. Chem. 56: 765 (1921).

Our solubility value for nitrogen in water is only slightly higher than the usually accepted value (0.01272),[10] while the value for helium in water is 0.022 volumes percent higher than the average reported by Hawkins and Shilling.[12]

The following solubility ratios have been computed from the values in table 1:

Helium/nitrogen in water	2 to 3
Helium/nitrogen in oil	1 to 4.5
$\frac{\text{Helium in oil}}{\text{Helium in water}}$	1.7 to 1
$\frac{\text{Nitrogen in oil}}{\text{Nitrogen in water}}$	5.24 to 1

It is observed that the oil/water solubility ratio for helium is only one-third of the corresponding value for nitrogen.

Fat/Blood Solubility Ratios for Helium and Nitrogen

The solubility of helium in blood [12] is about 1 percent higher than our value for the solubility of helium in water. Since the solubility of nitrogen in blood [10] is also 1 to 2 percent higher than the solubility of nitrogen in water, and since the solubility of the gases in oil is of the same degree as their respective solubility in body fat, it can be concluded that the fat/blood solubility ratio for helium is also only one-third of the corresponding ratio for nitrogen.

Application of Results

The comparatively low solubility of helium in fat is highly significant. Since fat and fatty tissue take up gas through the medium of the blood stream, this type of tissue governs the time required for the body as a whole to come into equilibrium with a given pulmonary gas tension.

With reference to nitrogen elimination from the body when oxygen is breathed, Behnke, Thomson, and Shaw [13] have pointed out that after the first hour the eliminated nitrogen comes mainly from fat and lipoid tissue. At the end of 6 hours nitrogen elimination had decreased to a value of about 7.5 cubic centimeters per hour. These measurements indicated that after 9 hours the body had lost 99 percent of its nitrogen content.

Campbell and Hill [14] using an entirely different method of determining tissue saturation concluded that 12 hours or more would be required for complete desaturation.

[12] Hawkins, J. A., and Shilling, C. W. Helium Solubility in Blood at Increased Pressures. Journ. Biol. Chem., 113: 649 (April, 1936).

[13] Behnke, A. R., Thomson, R. M., and Shaw, L. A. The Rate of Elimination of Dissolved Nitrogen in Man in Relation to the Fat and Water Content of the Body. Amer. Journ. Physiol., 114: 137 (December, 1935).

[14] Campbell, J. A., and Hill, L. J. Quart. J. Exper. Physiol., 23: 197 (1933).

On the basis of a blood/fat solubility ratio one-third that of nitrogen, helium should require from 3 to 5 hours for 99 percent elimination measured after the body had previously been in equilibrium with a given pulmonary tension of this gas.

The Helium Content of the Body

In a man weighing 60 kilograms the water content may be estimated at 70 percent or 42 kilograms, and the fat content at 13.2 percent or 7.92 kilograms. The helium content of the body at atmospheric pressure (helium tension in the lungs, 570 millimeters) may then be computed in the following manner:

	Cubic centimeters
0.00654 (a, H_2O, 570 mm.) × 42,000	273
0.0111 (a, fat, 570 mm.) × 8,800 (corr. for S. G.)	98
Body total	373

In a man weighing 60 kilograms the nitrogen content was found to be 840 cubic centimeters.[13] The helium content should be, therefore, about 45 percent as high as the nitrogen content of the body when the gas tension is the same in the lungs.

Possibility of Spinal Cord Injury Following Decompression From a Helium-Oxygen Atmosphere

Nitrogen emboli interrupting the blood supply to the thoracic and lumbar areas of the spinal cord produce the gravest complications of compressed-air illness, namely, paralysis affecting the lower extremities, intestines, and genito-urinary tract. Since the spinal cord consists of 27.5 percent fat,[13] a helium–oxygen mixture breathed in place of air should materially lessen damage to this vital tissue as a result of the comparatively low solubility coefficient of helium in fat.

SUMMARY

1. The solubility coefficients of helium in water and in oil have been determined and compared with the coefficients for nitrogen stand in the ratio of 2 to 3 for water and 1 to 4.5 for oil, respectively. From these values the helium content of the body should be about 45 percent as high as the nitrogen content when the same tension of each gas is breathed.

2. The decreased solubility of helium in fat compared with nitrogen should decrease the elimination time of this gas from the body and lessen the possibility of spinal cord injury.

TABLE 1.—*Helium, nitrogen solubility in water and in olive oil at 38° C*

Water		Olive oil	
α He	α N_2	α He	α N_2
0.00869	0.01274	0.01489	0.06689
0.00867	0.01269	0.01482	0.06653
0.00877	0.01273	0.01477	0.06668
0.00874	0.01283	0.01485	0.06669
		0.01467	0.06685
Average: 0.00872	0.01275	0.0148	0.06673

III. MENTAL REACTIONS IN A HELIUM-OXYGEN ATMOSPHERE COMPARED WITH THOSE OCCURRING IN AIR

Behnke, Thompson, and Motley [15] first attributed the remarkable narcotic (intoxicating) effects of air at high pressures to the "atmospheric nitrogen." [16] It is worthy of note that although diving and caisson work had been in progress for a great many years, disturbances in motor control and behavior while occasionally recognized by alert diving officers (e. g. Saunders' report of the salvage of the *S-4*) were described in the literature for the first time by Hill and Phillips in 1932.[17]

In regard to the manner in which nitrogen affects these disturbances it has been pointed out [15] that its action might be related to its high solubility coefficient in fat compared with water. Thus, an analogy could be drawn comparing nitrogen with the aliphatic anesthetics, the activity of which according to the Meyer-Overton law appeared to be related to their ratio of solubility in fat compared with water.

The practical conclusion drawn from these observations [15] was summarized by stating that—

> An artificial gas mixture for divers is essential if operations at great depths (below 300 feet) are carried out * * * Such a mixture, of course, should limit the oxygen concentration to that in the air at sea level, and in addition should provide a rapidly diffusible, sparingly soluble gas with a low partition coefficient.

The gas contemplated was helium but its cost at that time (1935) did not render it available for large scale diving operations. Improved methods of application made its use more practicable and 3 years later an opportunity was afforded at this unit to substitute

[15] Behnke, A. R., Thompson, R. M., and Motley, E. P. The Psychologic Effects From Breathing Air at 4 Atmospheres Pressure. Amer. Journ. Physiol., 112: 554 (1935).
[16] Includes Argon.
[17] Hill, L. and Phillips, A. E. J. Roy. Nav. Med. Service, 18: 165 (1932).

a helium-oxygen atmosphere for air in depths up to 500 feet (16 atmospheres). It was possible, therefore, to test the belief that helium would free divers from the untoward effects of air,[6 15] and also to corroborate the finding that atmospheric nitrogen was responsible for these phenomena.

Essentially the helium-oxygen atmosphere abolishes, or renders negligible, the stupefaction and impaired motor control associated with air respiration under pressure. At a depth of 500 feet, for example, the diver felt well and was conscious of being at a depth of not more than 100 feet. The sensation of pressure or depth by which experienced divers breathing air can estimate to within 50 feet the actual depth is uniformly absent in a helium-oxygen atmosphere.

In contrast to the feeling of normality experienced in the helium atmosphere at deep depths is the complete change brought about by replacement of helium with air, the oxygen concentration remaining constant. The sudden introduction of air at a depth of 300 feet to a diver breathing helium produced a sensation of "floating away," dizziness, and loss of muscular control, accompanied by an insistent demand to be brought to the surface. In effect the diver was experiencing the first stage of inhalation anesthesia.

It would be of some value, perhaps, if arithmetical tests could be used to evaluate the reactions associated with the respiration of various gases under pressure. Such tests, however, are not practicable at the present time under our conditions of work. We have observed, for example, that arithmetical tests were of little value, since the effort and practice factors inherent in such tests rendered the interpretation of results difficult or invalid.

Since the air pressure disturbances are similar in many respects to those produced by alcohol, another narcotic substance, it seemed worth while to select a practical test of motor function from this carefully investigated field.[18] It appeared that typewriting involving as it does a complex, continuous skilled act, would give data indicative of the manner in which a diver would perform his tasks under pressure. In this test the continuous performance renders subjective reinforcement (possible in intermittent tests such as marksmanship) difficult, or detectable by a slower rate of typewriting. The practice factor can also be eliminated by using skilled typists as subjects.

These data were obtained when a skilled typist breathed air and a helium-oxygen mixture alternately at various pressures (depths) in a large steel chamber.

[18] Emerson, H. Alcohol and Man, p. 237. The MacMillen Co., New York, 1935.

	Air	He-O_2
Surface:		
Words per minute	63.2	69
Errors per stroke	0.0032	0.0052
200 feet:		
Words per minute	53.0	63
Errors per stroke	0.0135	0.005
250 feet:		
Words per minute	60.0	55.8
Errors per stroke	0.011	0.0057

Comparable to the alcohol tests[18] are the clumsy mistakes made in the copy (whole sentence omitted at 250 feet) greatly decreasing its legibility when air was breathed under pressure. Impaired judgment, a characteristic effect of high air pressure, is brought out by the fact that the typist realizing that he was making errors while breathing helium slowed down his rate of copy. Breathing air, on the other hand, gave him the feeling that he was doing exceptionally well and consequently he made no effort to decrease his speed.

Manner of Action of "Atmospheric Nitrogen" at High Pressures

The low partition coefficient (fat/water solubility ratio) of helium (1.7 to 1) in contrast with nitrogen (5.24 to 1), and the comparative freedom from pressure effects when helium is breathed, give us a working hypothesis toward an understanding of the action of nitrogen discussed in a previous paper[15]. While the nature of all narcotic activity is obscure, the relationship between narcotic potency of different alcohols and anesthetics and their relative fat and water solubilities as demonstrated by Meyer and Overton, may well apply to the narcotic action of gases. Specifically, an alteration brought about by adsorption or concentration of these fat solvent substances in the fatty components of the surface film of the nerve cell is thought to decrease cell membrane permeability with resulting narcotic effect.[18]

Other differences between the two gases (argon should also be considered with nitrogen and is included in the term, "atmospheric N_2") as an explanation of their opposite behavior may be related to the electronic inertness of the helium atom, depriving it of valence and the ability to combine with any known substance, in contrast with nitrogen which is electronically active, possesses valences of 3 and 5, and combines with many substances.

Limiting Depth When Helium Is Breathed

The limiting depth when air is breathed may be placed at 300 to 350 feet. If its narcotic action is related to its partition coefficient, then helium with only one third the partition coefficient of nitrogen should enable divers (considering only the mental effects) to descend to a depth of about 1,000 feet.

SUMMARY

In a helium–oxygen atmosphere the narcotic effects of "atmospheric nitrogen" at corresponding high pressures are largely dispelled. The comparatively low fat/water solubility ratio of helium compared with nitrogen suggests the applicability of the Meyer-Overton law toward an understanding of the nature of nitrogen narcosis.

IV. HELIUM CONTENT OF THE BODY AND ITS RATE OF ELIMINATION

Measurements of the rate of helium elimination from the body are essential for the calculation of decompression tables for divers.

Experimental Procedure

First-class divers representing carefully selected and trained men whose ages ranged usually between 25 and 35 breathed a helium-oxygen mixture for periods averaging 3½ hours either at atmospheric or increased barometric pressure. Following the period of helium respiration air or oxygen was rebreathed from a spirometer of the Benedict type. Analysis of spirometer gas for its helium content made possible the measurement of the body's helium content, and its rate of elimination.

Analysis of large samples of gas (500 cc.) enabled us to measure quantities of helium as small as 1.5 cubic centimeters eliminated from the body during a half-hour period of rebreathing, and to recover about 99 percent of the body's helium content. For our purpose we considered helium elimination complete when less than 1.5 cubic centimeters were given up by the body during a half-hour period.

The gas mixture breathed by the divers contained 73–76 percent helium, 5–7 percent nitrogen, and 19 to 20 percent oxygen.

Analysis of Helium

Helium can be separated from other inert gases by a physical method based on its low liquefying temperature. In the Cady apparatus activated charcoal is used to absorb nitrogen and gases other than helium at the temperature of liquid air (−189°). By means of a high vacuum applied to the charcoal the helium can be extracted, and subsequently measured in a burette.

A spectrum tube serves to identify helium, or impurities in the system, and to determine the approximate concentration of helium gas.

Computation of the Helium Tension in the Body

The helium tension in the body at the end of a 3½ hour helium-oxygen exposure was computed from the helium content of the urine instead of the helium percentage (73–76) of the inspired gas.

After 90 minutes of helium-oxygen respiration the tension of helium in the urine is in equilibrium with the helium tension of the kidneys, arterial blood, and alveolar gas (see part IV). By analyzing a sample of urine voided after 90 minutes for its helium content, and equilibrating a portion of the same urine

with pure helium, we can compute the tension of helium in the urine from the formula,

$$\text{Tension helium} = \frac{\text{helium content urine}}{\text{helium content equilibrated urine}} \times B - W$$

where B is the barometric pressure and W the tension of water vapor.

TABLE 2.—*Helium elimination from a diver, age 29, weight 74 kilograms (162 pounds)*

[The average initial helium tension in the body was 413 millimeters]

Time	Helium	Percent of total	Rate corresponds to a 50 percent [1] desaturation time in—	Time	Helium	Percent of total	Rate corresponds to a 50 percent [1] desaturation time in—
	Cubic centimeters		*Minutes*		*Cubic centimeters*		*Minutes*
3 minutes	75	29.0	6.25	180 minutes	247	94.6	43.00
20 minutes	147	56.5	17.00	210 minutes	251	96.2	43.00
30 minutes	169	64.8	20.00	240 minutes	254	97.3	43.00
60 minutes	201	77.00	27.50	270 minutes	256.5	98.3	43.00
90 minutes	223	85.4	31.00	300 minutes	258.5	99.4	43.00
120 minutes	233	89.3	36.00	330 minutes	260.0	99.5	43.00
150 minutes	242	92.7	40.00				

[1] A tissue half desaturating in 43 minutes will be 99.5 percent desaturated in 330 minutes (7.7 time units).

DISCUSSION OF RESULTS

The graph (fig. 15) represents the helium desaturation curve of a diver, age 29, weight 74 kilograms (162 pounds). The average helium tension in the body (urine) during the period of exposure in the helium–oxygen atmosphere was 413 millimeters.

In table 2 are listed the data applying to fig. 15. The helium given up during the first 3 minutes (lung-rinsing period) of oxygen breathing was estimated from values obtained for the third minute and from values computed from the product of cardiac output and the helium solubility coefficient in blood.

From these data we conclude that the quantity of helium dissolved in the tissues of men of the same weight is about 40 percent of the nitrogen content [13, 19] for corresponding gas tensions in the body. The time required for helium elimination is about one-third to one-half the time required for nitrogen elimination.[13, 14] The difficulty of measuring with precision the end point of nitrogen diffusion from the body in an oxygen atmosphere does not permit at this time a closer comparison of desaturation rate for the two gases.

The decreased total elimination time for helium as compared with nitrogen is roughly proportional to the blood and fat solubility ratios

[19] Behnke, A. R. Application of Measurements of Nitrogen Elimination to the Problem of Decompressing Divers. U. S. Nav. Med. Bul., 35: 219–240 (April 1937).

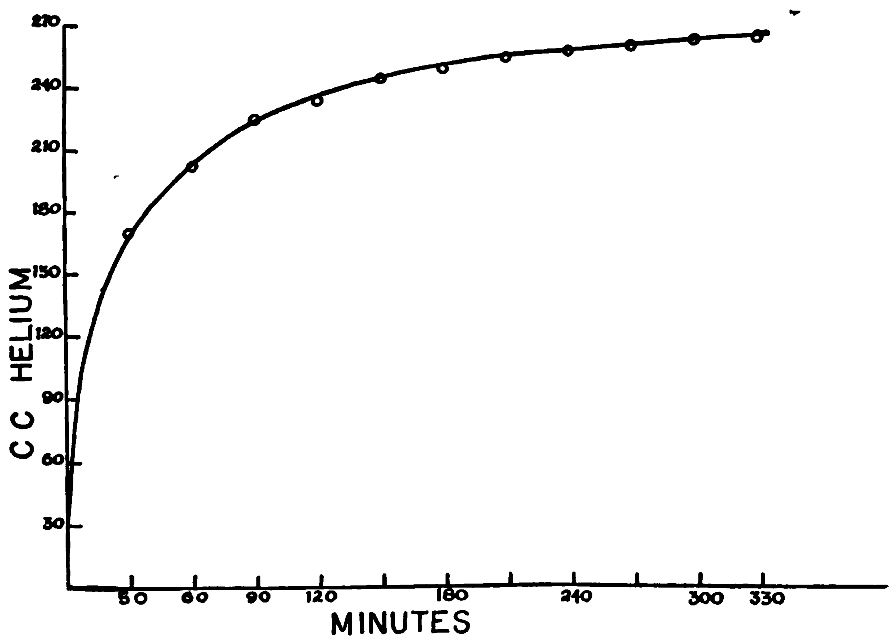

FIGURE 15.

of the two gases (viz. part II). Essentially it is the high solvent capacity of body fat for nitrogen that delays the elimination of this gas.[13] On the other hand, 50 percent desaturation time in contrast with total elimination time is about the same (20 minutes) for each gas. During this first 20-minute period gas elimination is taking place from body fluids.

Possible Error from the Absorption of Helium in the Intestinal Tract

The question may arise as to whether the small quantities of helium eliminated after fourth hour are given up by the tissues or alimentary tract.[20] Gas in the alimentary tract is mostly nitrogen, residual of swallowed air. When helium is breathed its entrance into the stomach and intestines occurs either by swallowing the gas or through diffusion from the blood stream. It is of interest to record that at one time experimental diving with helium was practically discontinued because the use of a mouthpiece for helium respiration resulted in swallowing large quantities of gas. During decompression the rapid expansion of the trapped gas caused intense, griping pains, and in addition created the possibility of gastric rupture.

To eliminate this source of error a test was conducted in which 500 cubic centimeters of helium were admitted to the small intestine

[20] McIver, M. A., Redfield, A. C., and Benedict, R. B. Amer. Journ. Physiol., 76: 108 (1926).

through a Rehfuss tube. A roentgenogram of the abdomen taken a half hour later revealed the gas distributed throughout the large bowel. Three and one-half hours later about 4.4 cubic centimeters of helium were recovered from air rebreathed in a spirometer during a half-hour period. While these quantities of gas would undoubtedly affect a precise determination of helium diffusion from tissues, it was doubtful whether or not such large quantities of gas would be normally retained. In a second experiment 200 cubic centimeters of helium were introduced into the small bowel. Between the fourth and fifth hour after the introduction of gas only 1.6 cubic centimeters were eliminated from the lungs.

These tests showed that under ordinary conditions helium either swallowed or diffusing into the intestinal tract during saturation will not introduce significant error in measurements of helium elimination.

SUMMARY

1. The helium content of the body is about 40 percent of the nitrogen content for corresponding gas tensions.
2. At atmospheric pressure 99 percent of the helium content is eliminated in five and one-half hours or in about one-half the time required for nitrogen desaturation.

V. THE NITROGEN OR HELIUM CONTENT OF THE URINE AS A TEST FOR BUBBLE FORMATION IN THE BLOOD STREAM

A simple test heretofore has not been available for estimating the efficiency of a given decompression schedule in promoting the elimination of excess gas from the tissues of the body without bubble formation.

Periodic measurements of the inert gas content of the urine provide a simple and effective test for detecting the presence of excess gas held in supersaturation or bubble form in the blood stream.

Leonard Hill[21] in 1907 made analyses of the gaseous nitrogen content of urine to determine the time necessary for kidney saturation. Subsequent investigators, however, have not continued Hill's work, nor have they applied the principle underlying the urine analysis method to the problem under consideration.

METHOD OF PROCEDURE

Urine from divers exposed to a helium-oxygen atmosphere under pressure and air during decompression, was collected before a dive (control sample), immediately after surfacing, and then at hourly

[21] Hill, L. Caisson Sickness, and the Physiology of Work in Compressed Air. Longmans, Green and Company, New York (1912).

intervals until equilibrium was again established between the inert gas tension in urine and lungs.

The manner of urine analysis was essentially the same as the technique used by Van Slyke and his coworkers in their nitrogen solubility studies.[10]

Since the solvent capacity of urine is decreased by the presence of dissolved salts it was necessary to equilibrate a portion of each sample by bubbling air through the urine for 15 minutes at a temperature of 38°.

The difference between the gas content of immediately analyzed urine and the equilibrated portion denoted gas held in supersaturation.

Principles Underlying the Experimental Results

A condition of equilibrium through the media of arterial blood and kidneys is assumed to exist between the inert gas tension in urine and lungs at constant barometric pressure. Disturbance of this equilibrium is effected when a diver is subjected to increased pressure by diffusion of gas from the lungs into arterial blood, kidneys, and urine. With the subsequent release of pressure, diffusion in the reverse direction occurs until equilibrium is again restored.

The time required for the reestablishment of inert gas equilibrium between urine and lungs will be delayed if gas bubbles are present in the blood, especially in the arterial blood circulating through the kidneys. That bubbles of gas circulate in arterial blood in the early stages of compressed air illness (bends) has been observed by Behnke and Shaw.[22]

In this paper experimental data will be presented in support of these statements.

Discussion of Experimental Results

Inert gas (nitrogen) content difference between bladder urine and equilibrated urine at atmospheric pressure.—In 76 analyses the inert gas content of bladder urine was found to average 0.015 volumes percent higher than the gas content of urine through which air was bubbled for 15 minutes. The greatest difference was 0.039 volumes percent. In 8 analyses the gas content of bladder urine was slightly lower (from 0.006 to 0.016 volumes percent) than the gas content of equilibrated urine.

Inert gas (nitrogen) content difference at increased pressure.—At 2.2 atmospheres pressure the same difference, or 0.015 volumes percent, was found to occur between bladder urine in equilibrium with lung air and urine equilibrated with air at the same pressure.

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[22] Behnke, A. R., and Shaw, L. A. The Use of Oxygen in the Treatment of Compressed-Air Illness U. S. Nav. Med. Bul., 35: 61-73 (1937).

Barometric pressure changes in relation to equilibrium time.—Between 30 and 60 minutes was required for the establishment of equilibrium (saturation) between the pulmonary and urinary gas tensions when the barometric pressure was raised; that is, in a pressure chamber or diving suit.

When the excess pressure is lowered to normal the same time is required for the restoration of gaseous equilibrium (desaturation), provided that the excess pressure is not too high (above 7.5 pounds) or the return to normal too abrupt. Desaturation time is prolonged by rapid decompression from higher pressures. This delay is undoubtedly the result of increased nitrogen tension in the arterial blood reaching the kidneys and is possibly indicative of gas embolism.

Variation of inert gas content in the lungs in relation to the excess gas content in the urine.—In table 3, values are given for the excess inert gas in urine for periods up to 4 hours following the decompression of divers from a depth of 225 feet. On the bottom the divers breathed a helium-oxygen mixture and, during decompression, air. It is observed that the higher inert gas tension in the lungs is reflected in higher urinary gas contents.

Excess gas content in the urine in relation to bubble formation in the blood (bends).—In table 4, data are presented showing the relationship between the gas content of the urine and the occurrence of bends. The divers breathed a helium-oxygen mixture on the bottom and air during and following decompression. The control values in column 3 were obtained by analysis of urine voided immediately before a dive. Immediately following a dive the bladder was again emptied. The values in columns 1, 2, and 3 thus represented analyses of urine voided at the end of the first, second, and third hours, respectively. In these specimens, with one exception, helium could not be detected by our analytical methods.

We have come to regard the gas content values of the second hour (column 5) as of great importance since under the system of decompression employed, high values were associated with the development of bends while normal values (below 0.04 volumes percent) were obtained on divers who remained free from symptoms. In only one instance did bends occur following a normal 2-hour gas-content value.

On the other hand, high 2-hour values may not be followed by bends. Thus, diver Z. A. M., who up to date has been immune to bends, showed high values during the second and third hours. However M. A. C., who on the following day was subjected to the same diving conditions, developed severe bends.

Some factor apparently enables certain individuals to hold gas in supersaturation in the blood, or, if bubbles form, the blood flow, as a result of increased heart action or abundant collateral circulation, is sufficient to maintain adequate tissue nutrition. In this connection,

End [6] has called attention to the association of bends and the presence of high concentrations of carbon dioxide in caissons as reported in the literature. At this unit Lieutenant Commander Momsen has had an opportunity to make tests on two occasions in which a high carbon dioxide content in the diver's gas mixture was followed by the development of bends. In control tests duplicating the conditions of the previous dives except for a lowered carbon dioxide tension in the inhaled gas mixture, the divers remained in excellent condition.

That the body can tolerate gas bubbles in the blood stream is indicated by the inert gas values for the first and second hours obtained on B. U. G. This excess gas was found on analysis to be helium, the only instance in which we have been able to detect helium in the urine 1 hour after decompression and about 2½ after exposure in a helium-oxygen atmosphere. The existence of helium in bubble form in the blood is our only explanation for the prolonged presence of helium in the urine.

Further evidence of the presence of bubbles in blood associated with minor, and frequently prodromal symptoms of bends are brought out in tests involving a 2-minute return to normal pressure after a 30-minute exposure to a pressure of 4 atmospheres. Transient sequellae of such tests are skin itch and petechial rash indicative of bubbles in the cutaneous vessels. In explanation of this phenomenon it appears that gas in supersaturation is trapped in the skin vessels as a result of vasoconstriction brought about by the chilling cold associated with rapid decompression in a chamber. Subsequently, with an increasing differential pressure the gas in supersaturation is released in the form of bubbles.

Diffusion of helium through the bladder wall.—An important consideration in any study of urinary gas content is diffusion of gas through the bladder wall when the urinary gas tension is higher than the gas tension in the blood. During exposure in a high pressure helium-oxygen atmosphere the tension of helium in urine approaches equilibrium with the helium tension in the lungs. During decompression, however, the bladder urine loses about nine-tenths of its estimated helium content. This loss of helium undoubtedly takes place by diffusion through the bladder wall. The fugacity of helium is also greater in a distended bladder because, presumably, the stretched wall allows the gas to diffuse from urine more rapidly into the blood where the tension of helium is lower.

In an experiment designed to measure helium loss from retained bladder urine, 153 cubic centimeters of normal saline saturated with 1.63 volumes percent helium at two atmospheres pressure were introduced by catheter into the bladder. Three hours later the voided urine-saline mixture contained a helium content of only 0.07 volumes

percent. Making allowance for the dilution of saline by secreted urine, it was computed that nine-tenths of the original content of helium had diffused into the blood stream through the bladder wall.

Summary

Periodic measurements of the inert gas content of the urine provide a simple and effective test for detecting the presence of excess gas held in supersaturation or in bubble form following the release of divers from high pressure atmospheres. By means of this test a quantitative estimate of gas elimination from the body can be obtained, and the occurrence of bends frequently can be prognosticated.

Data are presented indicating that helium diffuses through the bladder wall.

TABLE 3.—*The 225-foot dives, 20 minutes duration, diver breathing helium–oxygen mixture on the bottom*

Diver	Date	Excess inert gas in urine (volumes percent)				Oxygen percentage in helmet on bottom	Remarks
		1 hour	2 hours	3 hours	4 hours		
M. A. C.	Mar. 24	0.186	0.049	0.042	0.013	12.8	
	Mar. 25	.128	.035	.029	.013	21.1	
C. O. T.	Mar. 24	.266	.044	.031	----------	11.5	
	Mar. 23	.080	.009	.003	----------	20.6	
D. U. N.	Mar. 22	.134	.007	----------	----------	12.8	
	Mar. 24	.122	.002	----------	----------	22.9	
T. H. O.	Mar. 22	.132	.004	47-minute decompression		12.8	
	Mar. 25	.115	.020	42-minute decompression		21.7	
	Mar. 23	.105	.001	47-minute decompression		21.0	
M. E. T.	Mar. 28	.312	.044	.001	.01	9.8	
	Mar. 29	.104	.043	.009	----------	21.4	
F. O. R.	Mar. 23	.125	.031	.012	----------	12.0	
	Mar. 22	.110	.032	.021	----------	21.0	
F. R. Y.	Mar. 28	.149	.050	.001	.021	10.0	Itch,[1] rash,[1] fatigue.[2]

[1] Indicative of bubbles in blood vessels of skin.
[2] Frequent precursor of bends.

TABLE 4.—*Excess inert gas in urine in relation to the occurrence of bends*

Diver	Depth (feet)	Time on bottom (minutes)	Excess inert gas in urine (volumes percent)				Remarks
			Control	1 hour	2 hours	3 hours	
	(1)	(2)	(3)	(4)	(5)	(6)	
C. R. I.	350	20	0.018	0.11	0.05	0.017	Bends.
R. I. E.	350	20	.000	.05	.028	.017	No symptoms.
D. U. N.	400	20	.004	.099	.048	.041	Bends.
M. E. T.	400	20	----------	.13	.012	----------	No symptoms.
O. K. E.	400	18	----------	----------	.111	----------	Bends.
C. R. O.	400	18	.004	.18	.021	----------	No symptoms.
B. U. G.	375	20	.032	.20	.073	----------	Bends.
F. R. Y.	225	20	.029	.15	.05	.001	Mild bends.
M. E. T.	225	20	.015	.312	.044	.001	No symptoms.
B. U. G.	300	20	.009	[1].51	[1].35	----------	Cold during dive.
C. R. O.	350	20	.015	.14	.077	.005	Delayed bends.
Z. A. M.	350	20	----------	.17	.056	.051	No symptoms.
M. A. C.	350	20	----------	----------	----------	----------	Bends.

[1] Excess gas was helium.

THE HEALTH RECORD [1]

By J. S. Marks, Clerk in Charge, Medical Record Section, Bureau of Medicine and Surgery

INTRODUCTION

The individual health record (form H) now in use was adopted on January 1, 1911, with a view to greater accuracy, conciseness, and convenience. While on duty in the Bureau of Medicine and Surgery, Chief Pharmacist Charles E. Alexander, United States Navy, conceived the idea, devised the health record, prepared the instructions, and was instrumental in introducing this form to the naval service. Prior to 1911 an individual's medical record was not continuous, entries being made in a number of different medical journals, case papers, hospital tickets, and on other forms. These were not directly coordinated or, as a whole, generally accessible.

The present form H was substituted for the above papers in the case of each officer and enlisted man in the Navy and Marine Corps to accompany him throughout his various transfers to ships and shore stations or during periods of treatment in hospital; this record to be continuous and to contain the entire medical history in each particular case. The information thus available to a medical officer when a patient presented himself for treatment and a knowledge of the patient's previous medical record were important factors in determining the correct diagnosis, the origin of the disease or injury, and in prescribing an appropriate course of treatment. The Bureau of Medicine and Surgery was enabled by this procedure to furnish full information in any case, without the necessity, as previously existed, of requesting a complete transcript of service from the Personnel Divisions of the Bureau of Navigation and Marine Corps.

On January 1, 1911, all medical journals were closed and forwarded to the Bureau of Medicine and Surgery. Medical officers immediately opened a health record for each patient on the sick list, noting the fact that his medical history was continuous from a preceding entry in a medical journal. In order to avoid an overwhelming amount of clerical labor, health records for other officers and enlisted men in the service were issued only when they appeared for treatment. For officers appointed or promoted and for men enlisted on or after January 1, 1911, health records were immediately opened. All case papers closed during the calendar year 1910 were forwarded to the Bureau of Medicine and Surgery where they were indexed and made a part the permanent files of the Bureau. No new case papers were employed thereafter, but cases continued from 1910 were carried on the records until discharge, without the issue of health records.

[1] Editor's Note.—The new health record form described in this article was developed largely by the author. Mr. Marks served as a chief yeoman during the World War. Both before and since that enlistment he has served in the record section of the Bureau of which he is chief.

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Upon completion of such case papers they were forwarded to the Bureau of Medicine and Surgery. The library of medical journals contains over 5,000 irreplacable books, covering a period from 1812 to 1911. Approximately 40 percent of these books have been re-bound in canvas, and as funds become available it is the Bureau's intention to have the remainder of these valuable records re-bound. These records are consulted daily for medical histories as far back as 50 years.

In 1927 the procedure in handling health records of officers promoted to the next higher grade was revised resulting in a conservation of health-record covers. Prior to this time a new health record had been opened upon each promotion, only the abstracts were detached and appended to the new health record, while the old health record minus the abstracts was forwarded to the Bureau. This procedure was changed to require the opening of a new physical examination sheet (descriptive sheet) only, to be retained as top sheet by the medical officer for reference purposes. No part of the health record was forwarded to the Bureau. The writer was instrumental in this revision.

In 1930 Captain William E. Eaton, Medical Corps, United States Navy, revised the physical examination sheet (descriptive sheet) to include additional physical examination entries which have proved of great value to the Medical Department of the Navy and to the Veterans' Administration in the adjudication of claims.

NEW HEALTH RECORD—COMMENT AND INSTRUCTIONS

A new health record (Form H) will be issued to the service in the near future. This issue of the health record will be reconstructed in design. It will result in a saving of thousands of dollars to the Medical Department of the Navy in time, labor, and material. Of particular significance is the continuous use of the original health record cover and abstracts. A new physical examination sheet (descriptive sheet) only, is prepared in cases of reenlistments, extension of enlistments, transfer to the Fleet Naval Reserve, etc., in lieu of opening a new health record in its entirety.

A new abstract for "Record of refractions and physical qualifications for special duties" has been added. The provisions contained in this abstract will meet a long standing need. Concise entries of special examinations, refraction of eyes, physical examination for diving, submarine duty, and aviation will be readily available as a part of the permanent record. This abstract further provides for the new defects encountered on subsequent examinations for these special duties, thus becoming available as a ready reference for the individual's physical qualifications for such special duties.

The dental record will be inserted as the last page of the health record and the directions of the Bureau are that the original dental record be recharted as required. New dental records should not be inserted in the health record upon subsequent promotions of officers, appointment to officers' rank, reenlistment, and extension of enlistments.

The present practice of the Bureau concerning the preparation of health records for filing will be materially modified upon the adoption of this new record. Health records will be filed in their entirety in lieu of the present policy of removing covers and stapling sheets, a procedure which has proved unsatisfactory for reissue and for photostatic purposes. The substitution of a patented fastener will be an improvement and will eliminate the unsatisfactory clipping process.

A circular letter giving full particulars in connection with the latest issue of the health record will be prepared by this Bureau and mailed to all medical activities. The following instructions will be a part of that letter:

Officers

A health record shall be opened (issued) for each commissioned officer, upon first appointment, by the president of the board of medical examiners, or a member designated by him. Upon appointment of a warrant officer to commissioned rank, or an enlisted man to warrant rank, a new physical examination sheet (descriptive sheet) only shall be made out and inserted as the top sheet. The health record shall be retained in its entirety, at this time, with appropriate notations on the medical history sheet and cover.

In cases of promotion of commissioned officers to a higher rank the present procedure shall be used. (See paragraph 2202 (*b*), Manual of the Medical Department, 1938.) Upon completion of the annual physical examination each year, the descriptive sheet of prior rank, if promoted since the last annual physical examination, and all medical history sheets containing entries shall be detached from the health record and forwarded to the Bureau of Medicine and Surgery attached to the report of annual physical examination. (See par. 2217 (*a*), Manual of the Medical Department, 1938.)

Nurses

The same procedure shall be followed as in the cases of officers.

Enrollment and Reenrollments

The same procedure shall be followed for reservists as in cases of officers of the regular Navy.

Midshipmen

Appointment.—A health record shall be opened by the president of the board of medical examiners, or a member designated by him, and shall be continued intact until termination as midshipman.

Commissioned as ensign.—When commissioned as ensign appropriate notation shall be made on the cover, a new physical examination sheet (descriptive sheet) only made out, and the medical and dental abstracts retained. The balance of the health record (old descriptive sheet, medical history sheets, and record of vision and hearing) shall be closed by appropriate notation and forwarded to the

Bureau of Medicine and Surgery. Record of vision as a midshipman should be noted on refraction sheet.

Reenlistment

Upon immediate reenlistment a new physical examination sheet (descriptive sheet) only shall be made out by the medical officer. The cover and abstracts of previous enlistment shall be retained. The original service abstracts shall contain entries (red ink) as noted on the cover of health record for each reenlistment. The descriptive sheet of prior enlistment shall be closed under "termination of health record" and forwarded to the Bureau of Medicine and Surgery, together with the medical history sheets. When the individual does not reenlist immediately the health record shall be closed and forwarded in its entirety to the Bureau of Medicine and Surgery. Upon delayed reenlistment a new physical examination sheet (descriptive sheet) only shall be prepared by the medical officer and the cover and abstracts of previous enlistment shall be requested from the Bureau of Medicine and Surgery. Entries shall be made on cover and service abstract indicating reenlistment.

Extension of Enlistment

The same procedure shall be followed as in immediate reenlistment. The physical examination shall be made the day of expiration of current enlistment, or immediately prior thereto, and the findings shall be entered on a new descriptive sheet.

Transfer to Fleet Reserve or Organized Reserve

When an enlisted man of the regular service is transferred to the Fleet Reserve or Organized Reserve, a new physical examination sheet (descriptive sheet) shall be opened. The descriptive sheet of prior enlistment shall be closed under "termination of health record" and forwarded to Bureau of Medicine and Surgery, together with medical history sheets. Abstracts shall be retained. Health record shall be marked "Fleet Reserve" or "Organized Reserve" on the cover and forwarded to Commandant of Naval District to which the man is attached.

Do not use a new health record cover or a new set of abstracts upon promotion, reenlistment, extension of enlistment, or transfer to Fleet Reserve

An annual average of 300 health records of Navy and Marine Corps personnel are returned to ships and stations for proper termination of service. The entry of correct and complete information in the health record is important from the standpoint of adjudication of claims by the Veterans Administration and valuable for statistical study. A letter should accompany a health record forwarded to the Bureau for any reason other than termination of service.

The personnel of the Medical Department may be interested to know the magnitude of the Medical Records Section in the Bureau which embraces the receipt, classification, and filing of health records and the routing of correspondence pertaining thereto. At the present time there are on file over 1,400,000 individual jackets and the same number of identifying cards in the indices. In addition the library of medical journals contains over 1,000,000 case histories for the period from 1812 to 1911. The section in its entirety occupies 6,040 square feet of floor space and at the present rate of jacket expansion

(over 100 per day) an additional 144 square feet will be required annually.

During the period July 1, 1937, to June 30, 1938, a total of 44,371 health records were received and filed as a part of the permanent file of the Bureau. The health records of 545 apprehended deserters were returned to ships and stations for proper disposition.

THE PENALTIES OF UPRIGHT POSTURE

By Lieutenant REUBEN A. BENSON, Medical Corps, United States Naval Reserve

In the realm of comparative anatomical studies the student is impressed with the developmental variations which have been directed toward the production of a more efficient and better-protected organism. This holds true throughout the vertebrate phylum particularly. However, when the primate raised his anterior extremties from the ground and assumed the behaviorism which we characterize as being peculiar to man, he simultaneously acquired for himself ails we hear philosophically alluded to as those to which the flesh is heir. Structurally he is a marvel, and when one considers the intricacy of his mechanism we need only to be reminded of the untold number of things concerning our own bodies that we still do not know.

The human machine is, however, extremely vulnerable. We may use the airplane as an illustration. It is intricate, it is complex. It is a phenomenon of mechanical ingenuity, yet it is extremely vulnerable—vulnerable to its environment and also by virtue of its position in its environment. Consider the abdomen. It forms a comparatively large portion of the body in which lie very vital structures that are clothed by only a relatively thin and pliable wall of soft tissue. In addition this area is exposed on the anterior and advancing wall of the individual. Compare this with the fowl, a contrasting bipedal vertebrate which has its advancing wall protected by ribs, a heavy sternum well clothed with musculature, and an integument supplied with a thick downy growth.

One of the phenomena of biological science is the remarkable aptitude of the organism to adapt itself to its environment. This is demonstrable in many ways—protective coloration, integumental changes, skeletal variations, and rearrangements in internal and vital organs—all occasioned by environmental demands and directed toward preservation of the specie through increased protection and efficiency. But with this remarkable adaptability of the organism to meet the needs of its environment there has been an inadequacy in bodily adaptation to meet the requirements occasioned by the change in posture from the horizontal quadrupedal to the vertical bipedal.

First, let us consider the skeleton. In the quadruped the body weight is supported on all four extremities with the anterior members supporting the major portion of the weight and the posterior contribut-

ing the major portion of the motive force. In man it is necessary for the inferior extremities to supply the entire motive power and support. Further, a quadruped is inherently a mechanically stable entity, as would be a triped were there such, requiring nothing further than points of support for stability. However, with a biped stability is dependent upon equilibrium and a broad base. This has led to a laterally flattened foot in man which by virtue of its construction and necessity has increased in its scope of function and decreased in its efficiency. The structural integrity of the foot is maintained largely by the long plantar, the calcaneo-scaphoid, and the transverse ligaments. The "spring" in the foot is provided by the muscles, and they also are responsible for the normal posture of the foot. The function of the ligaments around the foot is also to limit the extremes of the range of movements. If the muscle tone is lost the ligaments are called upon to maintain posture and are subjected to unaccustomed strain; this injures the ligaments and gives rise to adhesion formation. This and allied conditions are grouped together for clinical purposes as "foot strain." This and the gross abnormality of pes planus (flat foot) are common entities and directly traceable to the excess functional demands made upon the inferior extremities of man.

The attempt to maintain equilibrium has led to further difficulties. The rapid twisting movements which we so deftly perform places excess strain on the sacroiliac articulation, the hip, knee, and ankle joints. Dislocations and fractures of the semilunar cartilages are sequelae.

Fractures and dislocations among the quadrupeds are relatively infrequent and rare when the animal is permitted to rely on its own resources, mental and physical, in its own environment. Under these circumstances fractures are limited almost entirely to those acquired in combat. Domestication of animals has increased the hazard of fractures many fold for two reasons: first, the complex environment into which they have been induced, and second, the inherent hazard of work in which the superimposed guidance of man takes precedence over their own instinctive judgment. A horse is ridden over rough and uncertain ground at a fast pace. He stumbles, falls, and breaks a bone. Every factor contributed to the misfortune—the weight and presence of the rider, rough and uncertain ground, a fast pace, not to mention the bit and bridle, none of which would have prevailed had the animal been allowed free in its own environment.

Man is nature's number one aspirant for honors for frequency and types of fractures. The reason for this being twofold. His creative ingenuity has made his environment dangerous to his own welfare and added to this is his own inherent vulnerability. The relationships between man and his implements is somewhat akin to the dog that at first had a flea and later the fleas had the dog.

Stimson analyzed nearly 15,000 fracture cases and found 46 percent were of the upper extremity, 26 percent of the lower extremity, 12 percent of the trunk, 9 percent of the face and neck, and 5 percent of the head. Dislocations showed a percentage frequency of 89 percent of the upper extremity, 6 percent of the lower extremity, and 5 percent of the head and trunk. Forty percent of the entire total were of the shoulder joint. From these figures we cannot but be impressed with the frequency of fractures and dislocations of the upper extremity. To what can we ascribe this frequency? Falls against an outstretched arm are a common cause for Colles fractures, fractures of the clavicle, and fractures of the humeral head. Hyperabduction of the upper extremity is another common accident, producing fractures of the surgical and anatomical neck of the humerus and dislocations of the shoulder joint. Both of these causes are peculiar to man—the former because of his postural peculiarity and the second because of his dexterity with his superior appendage. The shoulder in both man and animals is an enarthrodial joint. We utilize the joint to the full extent of its motile ability—flexion, extension abduction, and adduction. With the quadruped, however, the motion is limited largely to flexion and extension, as seen in walking and running, with the extremity held closely to the body and a minimum of abduction and adduction. This aids in reduction of the hazard of hyperabduction and therefore eliminates a strong factor in humeral-head fractures and shoulder-joint dislocations. The frequency of fractures of the phalanges and metacarpi can rather be attributed to our manual specialization than to postural peculiarity.

Fractures of the femoral head and neck, the acetabular rim, and the pelvis can unquestionably in a great number of cases be attributed to the excess transmission of force through the involved bones due to erect posture.

Sacroiliac and lumbosacral disease are relatively common in man. These include strain, sprain, subluxation, and arthritis. With the entire weight of the trunk, head, neck, and upper extremity transmitted through these articulations they necessarily are subjected to a high degree of stress which is, roughly speaking, halved by the quadrilateral weight distribution. Arthritis has been mentioned. We need not limit ourselves to the sacral joints in its consideration but may include the spine, hip, knee, and ankle joints. In frequency of affection the spine and the knee joint are undoubtedly the foremost. Whether the stress, strain, and trauma that these joints are subjected to by virtue of their weight-bearing relationship is a factor in the development of arthritis is at best a conjecture, however, worthy of consideration.

A number of the conditions mentioned are attributed to postural defects and to these may be added scoliosis, lordosis, kyphosis, certain

pelvic asymmetries, genu varus, and valgus. It is undeniable that postural perfection will alleviate or improve many of these entities.

Let us turn to the vascular system. What, if any, have been the effects upon it by the assumption of the upright position? The vascular system, consisting of the heart, arterial, and venous systems, has two basic requirements to fulfill in order to meet the functional demands made upon it, namely, the maintenance of blood pressure and the maintenance of blood velocity. In the living animal, especially those like ourselves that walk upright, the actual pressure in the arteries of the various tissues must vary much with the position. In standing erect the small arteries of the feet are, in addition to other conditions, exposed to the weight of the column of blood standing above them. In the pendant arm the skin of the fingers is congested. If, however, the arm is raised above the head the skin may become blanched because now the column of blood from fingers to shoulder exercises a hydrostatic effect in the opposite direction.

The importance of this gravity effect is well illustrated by the splanchnic circulation. When an animal accustomed to going on all fours is held in a vertical position, the great vascular area of the abdomen is placed under an increased pressure due to gravity, and unless there follows a compensatory contraction of the abdominal arterioles, so much blood will accumulate in this portion of the system that the arterial pressure in the aorta will fall markedly or the circulation will stop entirely. In most cases compensation does take place and no serious change in the circulation results.

For similar physical reason the erect position in man may be dangerous when the compensatory reflexes controlling the arteries and reflexes of the abdominal wall are thrown out of action. This may happen in a faint or in a condition of anesthesia. Individuals who have been kept in bed for long periods suffer from giddiness and unsteadiness when they first attempt to stand or walk. It seems quite possible that the effect is caused by a fall in arterial pressure brought about by the dilatation in the splanchnic area. The added weight of the blood thrown on these vessels by the effect of gravity is not compensated by a constriction of the arterioles or an increased tone of the abdominal wall. This hydrostatic effect is also influential in the production of varicose veins, wherein the vessel wall is no longer able to maintain the weight of the column of blood which these walls have to support. Varicocele, hemorrhoids, passive congestion, portal stasis, and syncope are other conditions which an upright position influences and which are benefited by recumbency. Production of phlegmacia alba dolens (milk leg), involving usually the left leg, is favored by the crossing of the left common iliac vein by the right common iliac artery acting as a mechanical obstruction to venous return, and this condition is aggravated by upright posture

which puts the iliac arteries on a stretch and brings them more firmly against the underlying veins.

In order to maintain the circulation in the head and neck of man the heart is called upon to support a column of blood leading to these regions. This situation, coupled with the necessity of raising the column of blood from the trunk and lower extremities, does not exist in the quadruped. The amount of additional work this requires of the heart is probably very small; nevertheless over a period of years it represents many foot-pounds of energy. Whether or not this fact is of any importance as regards the strength and vitality of the heart is purely a conjecture. Myocarditis is, nevertheless, a frequent invader in the domain of human pathology.

Organically, there are numerous entities that are peculiar to and common in man. Various degrees of prolapsus are a not infrequent condition. The continuous weight of the viscera bearing down from above is important in the production of this condition. In prolapsus ani and recti the fascial and muscular supports have been insufficient to bear this stress. The position of defecation adds further insult to these tissues, wherein the additional force of the contraction of the abdominal muscles is added. In the horizontal animal the anus usually lies quite well retracted within the pelvic outlet and the perirectal fascia; the urogenital diaphragm and the extrinsic anal muscles are not continually subject to the strain that they are in man.

The uterus is supported by eight ligaments which serve to fix it quite firmly in the pelvis. The fixation, however, if analyzed, is much more competent toward keeping the uterus from falling upward into the abdominal cavity than downward, the former being the direction of fall were we quadrupeds. Retroversion and retroflexion, common as they are, can attribute much of their frequency to the weight of the viscera bearing down from above. Cystocele and rectocele with incompetence of the pelvic floor are peculiar to us and largely occasioned by the continuous weight from above.

Herniae in animals are largely confined to the umbilical type and occasionally they are of the ventral variety caused by traumatic rupture of the abdominal muscles. In addition to these varieties in man we have the very common situation of inguinal hernia in its numerous variations and also femoral hernia. The weakness of the abdominal wall at the inguinal ring is patent. This holds true for both man and animals. However, in the latter this area of weakness is protected by the thigh being folded over it and no stress from the abdominal contents are directed against it. In the erect posture, however, the region is entirely exposed and in addition the weight of the viscera bears down upon the area, giving a double factor working toward the production of a herniation of the abdominal contents.

In gastroenterology, visceroptosis, and gastroptosis are two definite and well-defined clinical as well as pathological entities. Obviously the upright posture is responsible for the existence of these conditions, for were the patient put to the "monkey walk", such as gynecologists prescribe for uterine malpositions, gravity itself would correct the displacement. In our vocabulary we have two words which are quite significant, namely, "hypochondria", alluding to the stomach, and "hysteria", literally translated as "of the uterus." Our application of these terms relate to abnormal conditions of the mind and the words are well chosen. From the stomach and from the uterus comes the impetus to many abnormal conditions of both the mind and the body, and many, if not the majority, are occasioned by putting these organs in a position in which their normal function is hampered. One need only to read the advertising pages of our press to be convinced that the public is gastrointestinally conscious to a point of a neurosis. The reason for this is manifold, only to mention our avarice for a variety of food which at best certainly must tax the ingenuity of the digestive mechanism; our sedentary habits; the awkward manner in which we force the stomach to pass it on to the intestine, and the method of its final elimination. It might be suggested that after a full meal we attempt to substitute the horizontal position for the soda.

It is to be trusted that the foregoing discussion has in no way savored of cynicism and to that end may we again be reminded of the huge scope, function, and intricacy of the human machine which is capable of all this in all sorts and types of environment.

CLINICAL NOTES

AN UNUSUAL CASE OF INJURIES MULTIPLE EXTREME

By Lieutenant FREDERICK R. LANG, Medical Corps, United States Navy

The following case is presented because of the extensiveness and unusual severity of the injuries sustained, together with the fact that the patient survived and actually was returned to duty.

It illustrates forcibly the tremendous powers of recuperation and repair enjoyed by youth during the first two decades of life, and demonstrates how important this factor is in the prognosis of a case and the ability of the human body to withstand both the immediate and remote effects from severe injury.

On the morning of June 25, 1937, the U. S. S. *Nevada* while proceeding north along the California coast unexpectedly encountered unusually heavy seas which were shipped over the forecastle. A group of men working there at the time were caught, swirled about the deck, and thrown against the turrets and deck gear. Three of these men sustained injuries of such severity as to require transfer to the hospital ship later that day. One of this group, A. R. G., age 19, seaman, second class, sustained a combination of severe multiple injuries, each of which alone caused sufficient shock and hemorrhage that could have resulted fatally despite the prompt treatment rendered.

A. R. G. was admitted to the U. S. S. *Relief* on June 25, 1937, with the diagnosis of injuries multiple extreme, approximately 6 hours after being injured. He was in a partial state of shock. He was semiconscious and could be aroused with difficulty. Respirations were rapid, shallow, and of the air-hunger type. His skin was cold and clammy and his pulse rapid, weak, and thready. There was a large diffuse ecchymotic contusion overlying the area of the sixth, seventh, and eighth ribs in the midaxillary line. Chest expansion was limited, unequal, and shallow. The percussion note was tympanitic at the base of the left side of the chest. Breath, voice, and whispered voice sounds were diminished in the same area.

On percussion, the right border of the heart was found to be 4 centimeters to the right of the sternum. The heart sounds were feeble, distant, and of poor quality.

Palpation of the abdomen revealed a marked boardlike rigidity, accompanied by a generalized tenderness throughout. There was dullness on percussion in both flanks. The abdomen was not greatly distended. Peristalsis was not audible. There was a posterior dislocation of the right hip, which was surrounded by what appeared to be a hematoma of tremendous size. The right leg was approximately 2 inches shorter than the left, and was fixed in a position of eversion, with partial flexion of the thigh.

The impression on completion of the physical examination was—

1. Intra-abdominal injury of an extreme nature.
2. Intra-abdominal hemorrhage.
3. Massive collapse of the left lung.
4. Fracture, simple, of the left sixth, seventh, and eighth ribs.
5. Posterior dislocation of right hip.
6. Contusion, severe, left chest.
7. Massive hematoma, right thigh.

He was prepared immediately for operation, and while undergoing preparation was given 1,000 cubic centimeters of 5 percent glucose in normal saline in an effort to restore blood pressure. Under novocaine spinal anaesthesia, an exploratory laparotomy was performed. The abdominal cavity contained considerable blood. The chief source of this hemorrhage was from the pedicle of the spleen which was completely fragmented and scattered throughout the abdominal cavity. The largest piece was found to be about the size of a large walnut. The splenic pedicle was ligated and blood and fragments of spleen removed from the abdominal cavity.

Further exploration revealed two traumatic tears in the left side of the diaphragm. Both were about 3 inches in length and were situated near the left crus. There was some oozing from ruptured vessels here. These openings had a valve-like effect with each respiration. The left lung could be seen in a completely collapsed state, and there was a large amount of blood in the left side of the thoracic cavity. In the abdominal cavity a large hematoma had dissected downward along the left common iliac. The traumatic herniation of the diaphragm were sutured after the blood had been aspirated from the thorax and the abdomen closed. While on the operating table the dislocation of the right femur was reduced and the patient was given a transfusion of 500 cubic centimeters of blood by the Scannell method. At this time his red blood count was 2,170,000. On leaving the operating room his condition was very poor. On the next day his red blood count was 3,140,000.

Two days later, on June 27, 1937, he was again given 500 cubic centimeters of blood by the same method. Following this, his pulse became full and strong, and the patient became mentally clear for the first time. His temperature had gradually risen to 104.2°, and respirations continued to be dyspnoeic. On the same day his chest was aspirated and 250 cubic centimeters of partially decomposed blood was removed. An effort was made to create a negative pressure in order to relieve the respiratory embarrassment resulting from collapse of the left lung.

An X-ray of the chest taken on June 28, 1937, showed the collapse of the left lung, a fluid collection at the base of the left side of the chest, and fractures of the ninth and tenth ribs on the left side in their postero-lateral aspects, with some displacement. There were also fractures in the antero-lateral regions of the eighth and tenth left ribs.

On July 2, 1937, he was given another transfusion of 500 cubic centimeters of whole blood. From this point he began a slow general uphill trend. About this time it was discovered that he had a partial paralysis of the right peroneal muscle group. Over a period of several days this gradually became complete and he ultimately had a foot drop.

His pulse and respirations gradually subsided to normal over a period of several weeks.

The red blood count was 3,170,000 on July 2, 1937, after the transfusion. On the next day, July 3, 1937, 8 days after the operation, a considerable fluctuation was noted in the abdominal incision. Three sutures were removed and about 140 cubic centimeters of sero-sanguinous material was evacuated. Apparently, this came from between the muscle layers and did not originate from the peritoneal cavity.

On July 3, 1937, red blood count was 3,720,000. Physical findings and X-ray showed a gradual reexpansion of the left lung. Sero-purulent discharge from the abdominal incision gradually subsided; temperature, pulse, and respirations approached normal; and his general condition showed a steady progressive improvement. However, despite mild forms of physiotherapy, there was no suggestion of return of function of the right peroneal muscle group.

On August 2, 1937, because the hospital ship was to undergo overhaul, the patient was transferred to the Mare Island Hospital.

It is apparent from the first two survey board reports, that the medical officers on the boards despaired of his returning to duty because of failure of the right peroneal muscle group to regain full motor function. His abdominal incision finally healed completely with considerable scarring. His board of survey of December 27, 1937, reported that he had shown a slow, steady improvement, except for the foot drop, that he was up and about with the aid of a cane, and that his probable recovery to a duty status was doubtful. However, he must have shown a rapid return of function between this date and February 26, 1938, when he was discharged to duty, after having been on the sick list a total of 246 days.

REMARKS

Either one of the three major injuries (fracture of the spleen, abdominal hemorrhage, or traumatic massive collapse of the lung) might have resulted fatally from shock or loss of blood. Rupture of the diaphragm may result in death from shock, because of the injury to the delicate network of sympathetic nerves found in this area. Rupture of the spleen constitutes an acute abdominal emergency, and it is one of the few instances in surgery in which minutes count.

Sudden massive collapse of the lung results in a very grave condition in which the patient's life is feared for because such an accident results in a tremendous embarrassment of the respiratory and circulatory systems, which requires a tremendous readjustment. A combination of this, plus the resultant shock, will oftentimes result fatally, especially in an older patient. If the patient survives the first stages, he continues to be in grave danger from sudden shock, because of the continuous flapping back and forth of the heart and mediastinal contents with each cycle of the labored respirations. Furthermore, the loss of negative pressure in one side of the thoracic cavity results in the mediastinum being displaced toward the opposite side of the chest. This reduces the capacity of the remaining lung and further embarrasses the respiratory system.

CONCLUSIONS

The combination of dyspnoea, diminution in voice and breath sounds in the left chest, tympanitic percussion note in this same area, and displacement of the right border of the heart to the right made the diagnosis of collapse of the left lung comparatively easy.

Diagnosis of intra-abdominal hemorrhage was arrived at because of the findings of (1) sighing, "air hunger" type of respirations; (2) board-like rigidity of the abdomen; (3) dullness on percussion of the flanks.

ACUTE TRAUMATIC DIAPHRAGMATIC HERNIA: A CASE REPORT

By Lieutenant Commander J. M. BREWSTER (Medical Corps), United States Navy

The subject of diaphragmatic hernia has been so ably and thoroughly presented by Captain L. W. Johnson, (Medical Corps), United States Navy, in an article in the October 1936 issue of the United States Naval Medical Bulletin that no attempt will be made to discuss it in this report. Because it is a relatively rare condition which promises to become more common with the steadily rising number of violent automobile crashes, this case is being reported to add to our collective knowledge and experience.

CASE REPORT

History.—The patient, an enlisted man in the Navy, was injured at about 3:30 p. m. on the 20th of October 1936, when the car in which he was a passenger was struck broadside by a rapidly moving truck. He received emergency treatment at a civilian hospital before being transferred to this ship. He stated that he was rendered unconscious but regained consciousness before leaving the civilian hospital. He was admitted at about 10 p. m., complaining of very severe pain in the left side of the chest and the region about the left hip. The temperature was 98.8°; pulse 132; and respiration 18. A cursory examination disclosing evidence of a fracture of the pelvis and possible fracture of the ribs on the left. X-ray pictures of the pelvis and thorax were taken before the patient was put to bed.

Physical examination.—The patient was a well developed and nourished young male adult 23 years of age. There was a generalized macular rash over trunk, face, and extremities which disappeared on pressure and did not itch.

Head: There was a lacerated scalp wound 1-inch long in right occipital region which had been closed with a skin clip. Eyes, ears, nose, and throat negative. Pupils were equal, regular, and reacted to light and accommodation. Ear drums normal. Neck negative.

Chest: There was a small contusion on anterior wall below right nipple and a brush burn 2 by 8 inches on the right side in the posterior axillary line. No deformity or pain on compression noted. The lungs were clear with normal breath sounds throughout. The heart sounds were normal but at rate of 132 per minute. Blood pressure 122/58. The abdomen was scaphoid with board-like rigidity of muscles, preventing satisfactory examination. There was a wide contused area with pronounced swelling over the lateral and posterior aspects of the left ilium. Marked tenderness and bony crepitation noted in this area on palpation. No dullness noted in flanks. No hernia. Genitalia normal. Anus negative. Deep and superficial reflexes were present, equal, and active. Extremities negative except for pain on movement of left leg.

An emergency urinalysis was negative for evidence of gross damage to the genito-urinary system. Emergency red blood count, 3,790,000; Hgb, 75–80 percent (Tallqvist).

X-ray examination of pelvis, hips, and ribs.—Radiographic examination, stereoscopic study of the pelvis shows a comminuted fracture of the left ilium. The approximate anterior two-thirds of the ilium is broken off and displaced inward, the width of the fragment being approximately three centimeters. The posterior third of the crest forms a second fragment and retains approximately normal position. The body of the ilium is displaced inward and forward with the fracture line extending downward and backward to the midportion of the sacroiliac

synchondrosis, resulting in widening of the anterior half of the synchondrosis. There is an impacted, slightly overriding fracture of the superior ramus of the right pubic bone. There is also an impacted fracture near the junction of the decending ramus of the pubic bone and ischium. The fractures are smooth on the inner aspect, giving no indication of bladder injury from bone displacement. Radiographic examination, stereoscopic study of the rib cage shows the lower nine ribs bilaterally to be essentially negative for evidence of fracture.

Operation.—The high pulse rate, lowered red cell count and the rigid abdomen led us to believe that an intra-abdominal emergency existed with rupture of the spleen as the most likely condition. Accordingly, an emergency exploratory laporatomy was performed under spinal anaesthesia. No gas or free fluid was found within the peritoneal cavity. Injection of the omentum and small areas of the descending colon and portions of the small intestines were found indicating contusion. A large extraperitoneal hematoma surrounding the site of the fracture of the ilium was noted and seen to extend well up along the posterior lateral wall of the abdomen. The spleen and all other organs were found to be intact and apparently undisturbed. During the operation, he was given 1,000 cubic centimeters of 10 percent glucose in normal saline, and upon his return to the ward continuous hypodermoclysis of normal saline was begun. He was placed in a pelvic sling.

Postoperative.—The following day the fracture of the crest of the ilium was reduced and continuous traction by use of a towel clamp begun. The patient continued to complain of pain in the lower part of the left side of the chest. Examination of the chest at this time was essentially negative except that the heart sounds seemed muffled and diffused over the precordium and a rattling, clicking noise synchronous with the heart beat was heard at end of expiration. Temperature, 99–99.6; pulse, 92–120; respirations, 20–34.

The second day following the injury he first complained of dyspnea. The chest findings were essentially unchanged. He was given a back rest which relieved the dyspnea. He seemed much improved and accordingly the hypodermoclysis was stopped and he was put on a liquid diet. At 4:00 p. m. his temperature was 99, pulse 82, and respirations 20.

At about 7:00 p. m. he suddenly complained of severe pain in the left side of his chest and became quite dyspneic and cyanosed. The temperature had jumped to 101° with pulse of 120 and respirations of 32. He was examined by the officer of the day who found that the movements of the left side of the chest were markedly limited. There was tympany to percussion over the left chest up to the level of the second rib anteriorly with marked increase in the breath sounds over this entire area. The cardiac dullness at its widest portion extended barely 2 centimeters to the left of the sternum. An X-ray picture was taken with the portable machine which was reported as follows: "Radiographic examination, anteroposterior positions of the chest. Bedside examination shows complete collapse of the lower left lobe with heart and mediastinal contents displaced to the right. The left diaphragm is pushed downward. The resulting pneumothorax appears to be under positive pressure.

Accordingly he was treated as a case of pneumothorax.

On October 23, 1936, the third day after injury, his condition was essentially unchanged, there being marked dyspnea and cyanosis. The physical signs were the same except for signs of beginning hypostasis at the base of the right lung. With the marked displacement of the heart to the right and the apparent downward displacement of the diaphragm, it was concluded that a flutter valve perforation in the lung, creating a positive intrapleural pressure, was a likely possibility. With this in mind, the left pleural cavity was tapped using a 23-gage hypodermic needle. To our surprise, 300 cubic centimeters of air was all that could be aspi-

rated, and this was not under pressure. This gave the patient some relief from the dyspnea. A 20-gage needle was then inserted to a greater depth and about 1 cubic centimeter of a dirty brown fluid was all that could be aspirated. The true nature of the condition was then first suspected. The laboratory immediately confirmed our suspicion by reporting the fluid as stomach contents. A check X-ray made with needle left in place was reported. Radiographic examination, anteroposterior position of the chest. Check bedside examination with needle inserted shows the point of the needle in the pleural cavity. The contour of the air outline area suggests herniation of the stomach into the pleural cavity.

The patient was then given a small amount of thin barium mixture and another X-ray taken to establish conclusive proof of the diagnosis was reported. Radiographic examination, anteroposterior positions of the chest. Further check films with barium sulphate introduced into the stomach shows the stomach definitely to be well above the dome of the right diaphragm. The upper portion of the barium mass is at the level of the seventh dorsal vertebra on the left. There is considerable air above the barium filled area which may be the result of a pneumothorax or a dilated loop of the small intestines. There is evidence of beginning patchy pneumonitis of the opposite lung suggesting broncho-pneumonia.

By this time the patient's temperature had risen to 102 F, the pulse to 132, and the respirations to 31 per minute. The dyspnea had returned with some increase in the pain, with clinical and X-ray signs of beginning bronchopneumonia in the lower lobe of the right lung. It was agreed that an attempt at repair by operation under these conditions would be too hazardous. As an alternative a Levine tube was passed into the stomach through the nose and about 1,000 cubic centimeters of fluid and air aspirated through it. This gave the patient great relief from the dyspnea and cyanosis. He was started on a continuous intravenous clysis of 5 percent glucose in normal saline. About 1 hour later the patient suddenly collapsed and died a respiratory death. At no time were there any symptoms referable to the gastrointestinal system.

Autopsy report.—The positive autopsy findings were as follows: The peritoneal cavity contains about 500 cubic centimeters of thin hemorrhagic fluid filling the pelvis. There is a large opening in the left diaphragm, measuring 15 centimeters in diameter with a greater portion of the diaphragmatic muscle pushed to the medial line, and only a narrow fascial attachment remains along the costal border. The tear extends along the costal attachment of the left leaf from the region of the external lateral border of the quadratus lumborum forward to the region of the ninth costal cartilage. For a distance of about 1 inch in the posterior end of this tear there is a hematoma in the edges of both the leaf of the diaphragm and the tissues marking its attachment to the thoracic wall, indicating the original wound in the diaphragm. The stomach, the splenic flexure of the colon, the spleen, and the tail of the pancreas have passed through the tear in the diaphragm, filling the lower two-thirds of the left pleural cavity, causing pressure collapse of the lower lobe and lower half of the upper lobe, left lung. Extending from the diaphragmatic attachments on the left side to the ilium, there is extensive subperitoneal hemorrhage, being especially marked about the diaphragmatic attachments. There is also a subperitoneal hemorrhage over the left half of the pelvic region. The body of the ilium, including the crest, anterior superior spine, and down to and including the posterior spine, has been separated by a ragged fracture. The line of fracture is 4 centimeters from the crest and extends parallel to it.

The pancreas appears essentially normal with the exception of capsular ecchymosis about the tail.

Upon opening the thoracic cavity, the left pleural cavity is partially filled with stomach, spleen, splenic flexure of the colon, and tail of the pancreas.

There are about 500 cubic centimeters of a thin hemorrhagic fluid free in the cavity. The lower lobe, left lung is completely collapsed and the lung is pushed upward and to the median line. Normal crepitation is present only in the upper half of the upper lobe. The lower lobe and lower half of the upper lobe are completely collapsed and show a varying amount of hypostatic congestion. The right lung is free in the pleural cavity. The cavity contains about 500 cubic centimeters of bloody serous fluid. The lung is crepitant throughout with the exception of the lower lobe which shows hypostatic congestion and beginning lobular consolidations.

Pathological diagnosis.—1. Traumatic rupture, diaphragm, along attachments of the left leaf, extending from external lateral border of the quadratus lomborum forward to the region of the ninth costal cartilage.

2. Diaphragmatic herniation, stomach, spleen, splenic flexure of colon, and tail of pancreas.

3. Collapse, lower lobe, left lung.

4. Fracture, left ilium.

5. Contusions, multiple, gastrointestinal tract.

6. Terminal bronchopneumonia.

Comment.—Some of the observers of the autopsy believed that it was the jagged bone edge of the fractured ilium that caused the original wound in the diaphragm. The majority, however, felt that this would have been physically impossible without a fracture of the vertebral column which was not demonstrated and that the tear was the result of a bursting force.

The patient vomited while on the X-ray table just before the first picture was taken and as a result the stomach inflated with air was strikingly shown in its normal position, demonstrating that actual herniation had not occurred at that time. Mild dyspnea and abnormal chest findings on the second day following the injury may have represented a beginning herniation but it is believed that the wide secondary tear and massive herniation of abdominal viscera occurred on the evening of the second day, giving rise to the sudden pain, dyspnea, and cyanosis.

The extreme displacement of the heart and mediastinal contents to the right; the fact that the upper lobe of the left lung had not completely collapsed; and the reversal of the normal curve of the diaphragm were all strong evidence as to the true nature of the situation. The marked accentuation of the breath sounds heard over the effected area which was tympanitic to percussion was not consistent with a diagnosis of pneumothorax.

The lesion was missed at operation primarily because no free fluid, blood, or other evidence except possibly the bluish discoloration about the site of the fractured ilium was found to suggest it, and, secondly, because we had seen the original X-rays in which the diaphragm was noted to be in its normal position. The rigidity of the abdominal muscles may have been a lead but was interpreted as being the result of the fractured ilium when nothing was found within the peritoneum. Had the lesion been discovered at operation it is believed that repair would have been relatively easy and the patient's life might have been saved.

Gastrointestinal symptoms are given prominence in most textbooks as a diagnostic sign of diaphragmatic herniation. They were entirely absent in this case. This probably was due to the fact that the patient was given clear fluids by mouth and fluids were furnished by parenteral routes in quantities to combat possible post operative distension.

It is hoped that the lessons learned in this case will stimulate interest in the condition and prompt others to be on the alert for it in all cases of the severe trauma we so often see now as the result of automobile accidents.

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LESIONS OF THE CARDIAC PORTION OF THE STOMACH

TWO CASE REPORTS [1]

By Lieutenant H. H. Carroll, Medical Corps, United States Navy

Observers agree that most cancers of the stomach originate in the region of the pylorus and the adjacent part of the lesser curvature.

Regarding the usual site of chronic gastric ulcer, Boyd [2] states that 95 percent of chronic gastric ulcers are situated on the lesser curvature and posterior wall, particularly in the pyloric region. When it is considered that the ratio of incidence of peptic ulcer of the duodenum to that of peptic ulcer of the stomach is approximately 12 to 1, and that of this relatively small number of gastric ulcers 95 percent are located in the pyloric portion of the stomach, it is apparent that an ulcer of the cardiac portion is unusual.

The reason for this predilection of both benign and malignant lesions for the pyloric portion is unknown and consequently many theories are encountered. The cardiac portion plays a more or less passive part in the process of digestion and is relatively free from stress and strain, either chemical or mechanical. However, it is occasionally the site of pathological lesions, and two cases recently under treatment at this hospital are presented.

CASE REPORTS

Ruptured ulcer of posterior surface of cardiac portion of the stomach.

Case 1.—S. B. S., naval officer, age 41, was first admitted on September 10, 1937, with **diagnosis undetermined** (duodenal ulcer). He complained of upper abdominal pain and occasional belching.

History.—He stated that 10 years before he had been troubled for a couple of weeks with pains in the upper abdomen coming on 2 or 3 hours after meals, but that he finally took a course of calomel and this relieved him of his symptoms. At intervals since then he had had recurrences of epigastric pain coming on about 2 hours after meals and relieved by taking soda. For the past several months the relief from taking soda had not been so definite as formerly. His pain usually started in the left upper quadrant, well up under the costal margin and radiated down to the midline in the epigastrium. No history of vomiting, tarry stools, or loss of weight.

He had had measles and mumps during childhood. His systemic history, except as noted above, was negative. His father died of apoplexy at age 50, and his mother of Bright's disease at age 38. Social history irrelevant and habits normal.

Physical examination.—Only positive findings reported.

Throat: Some injection of anterior pillars.

Teeth: Many cavities, marked pyorrhea, and some gingivitis.

Abdomen: No definite points of tenderness noted although the skin of the entire abdomen was hypersensitive which made the abdomen difficult to palpate.

Prostate: Normal size and consistency, but secretion contained 30 to 40 white cells per high dry field.

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[1] From the Surgical Service of the U. S. Naval Hospital, San Diego, California.

[2] Boyd, W. A Text Book of Pathology. Lea and Febiger, Philadelphia.

Laboratory work was done as follows: R. B. C., 4,350,000; hgb. 95%. W. B. C., 17,200.

Gastric analysis: Fasting contents, 45 cc; free HCl, 20°; total acids, 28°. First specimen: Free HCl, 44°; total acids, 59°. Occult blood positive, lactic acid negative.

Stools were negative for ova and parasites. One stool specimen was positive for occult blood.

The blood Kahn was negative.

X-ray examination of the chest was reported as follows: Impression—Negative gastrointestinal series. A gall-bladder visualization with oral dye administration showed a normally functioning gall bladder.

Clinical record.—The patient was put to bed at time of entrance on a Lenhartz diet. This aggravated his symptoms from the start, as did the administration of alkaline powders. After a few days of no improvement under this therapeutic regime, and in view of the patient's statement that the fatty meal taken during the gall bladder visualization had very definitely caused an exacerbation of his symptoms, he was placed on a fat-free diet and this quickly and completely relieved him of all complaints. Because of this marked response to a fat-free diet and his intolerance for the Lenhartz diet and alkalis it was felt that he did not have a peptic ulcer. The most plausible explanation of his symptoms seemed to be a low-grade chronic cholecystitis, and the diagnosis was so established. A course of prostatic massages was instituted and three teeth were extracted because of marked pyorrhea. His pyorrhea and gingivitis were considered to be the source of the positive occult blood tests in gastric contents and stools. He was discharged to duty symptom free on October 9, 1937.

Except for occasional distress following a heavy meal the patient was symptom free until 1–20–38 when, at 4:30 p. m., he was seized with a sudden severe pain in the epigastrium. He was seen by his medical officer about 5:30 p. m., who made a diagnosis of ruptured duodenal ulcer and sent him to this hospital. He was admitted at 6:45 p. m. in a state of mild shock. His pulse rate was 100; his temperature 95° F. The skin felt cold and clammy, and he was perspiring freely. The chest and heart were negative. The abdomen was very rigid, especially in both upper quadrants. X-ray examination of the abdomen showed the right diaphragm to be high, and there was evidence of free gas in the peritoneal cavity.

Operation.—He was operated at 8:30 p. m. Under spinal anesthesia, later supplemented by ether, the abdomen was opened through the usual upper right rectus incision, and the peritoneal cavity was found to contain about a pint of gastric contents well distributed throughout the abdomen. This was aspirated and the duodenum and anterior surface of the stomach inspected for the perforation, but nothing was found. During manipulation of the stomach, gastric contents were noted entering the greater peritoneal cavity through the epiploic foramen. The lesser omentum was incised to enlarge the foramen and a large quantity of gastric contents rushed forth. An exploring hand could feel the ulcer on the posterior surface of the stomach, far to the left and nearer the greater curvature than the lesser. It was decided that a better approach could be made through a left rectus incision, so this was made. The omental bursa was entered through an incision in the greater omentum and the posterior surface of the stomach delivered into view. An oval perforation 3 by 10 millimeters was found on the posterior surface about 6 centimeters from the cardia. Its edges were approximated by a continuous running suture, and the abdomen was closed with drainage.

Postoperative.—The day following operation his general condition appeared very good, but from the second postoperative day he showed signs of a gradually increasing toxemia. A copious, foul-smelling, purulent discharge from the abdominal wound developed. Despite daily administration of 3,000 cc of 10 percent

glucose in physiological saline by vein, duodenal suction, digitalization, and the oxygen tent, his toxemia progressed and he died on 1–28–38.

Autopsy.—Excerpts from the autopsy report follow: The left lung has partially collapsed and the left pleural cavity contains approximately 200 cc of thin purulent fluid, pale green in color. There is a plastic exudate on the superior surface of the left leaf of the diaphragm. The peritoneal cavity is universally infected. Coils of intestines are adherent to one another by recently formed adhesions and many pockets of thin greenish purulent fluid are present within the coils of intestine. The posterior surface of the stomach shows a recently closed perforation which is covered by a plastic exudate and is closed by sutures. On removing the stomach and opening it, there is seen to be a large ulcer, triangular in shape, measuring 1½ inches on each side. The base is shallow except at one point where the abovementioned sutured perforation has occurred. The edges of the ulcer are somewhat elevated but are not firm or dense. The shallow unperforated portion of the base of the ulcer also lacks the firm fibrous feel of an old ulcer.

Microscopic report.—Microscopic sections of the stomach through the edge of the perforated ulcer show the gastric mucosa to be composed of mature adult epithelium with no evidence of neoplasm. The outstanding feature of the process is inflammation and a very moderate amount of fibrosis. Anatomic and microscopic diagnoses: 1. General peritonitis. 2. Bronchopneumonia. 3. Pleurisy with exudation. 4. Gastric ulcer, with perforation. 5. Parenchymatous degeneration of liver and kidneys.

Tumor, mixed, malignant (adenocarcinoma), of greater curvature of stomach.

Case 2.—R. L. S., naval officer, was admitted on 10–15–37, complaining of feeling weak and "run down," of pains in upper left quadrant of abdomen, and of the loss of 18 pounds in weight during the past 18 months.

History.—His pain started in May 1936; it was never severe, did not radiate, and had no relation to meals or foods eaten. Shortly after its onset he underwent observation and treatment at a naval hospital, where, he stated, the gastrointestinal X-ray examination revealed nothing of note, but the gastric analysis revealed the absence of free HCl in his stomach contents. He was told to go on a Sippy diet which relieved his symptoms somewhat. In August 1936 he suffered a recurrence and at this time he underwent study at Letterman General Hospital where again the gastrointestinal series was negative. He had had trouble most of the time between August 1936 and his admission here, although he would have occasional periods of a few weeks when he felt quite well. Occasionally he would vomit, but had not vomited since June 1937. He never vomited any blood and never noticed any tarry stools. In general he felt better on a modified Sippy diet, and he noted that any kind of alcoholic beverage would make him worse. A week before his entrance here he had gone to the Scripps Clinic in La Jolla where an X-ray study of the gastrointestinal tract had revealed the presence of a lesion of the stomach.

He had had measles and chickenpox in childhood. His systemic history was negative with the exception of the gastrointestinal tract. He had had enteritis in 1934 while in the Philippines; repeated search was made at that time and since for the ameba but none were ever found. Other than this enteritis, he had always had a good digestion prior to onset of present illness. His father died of cancer of the stomach at age 66.

Marital and social history was negative and his habits were normal.

Physical examination.—Only positive findings reported. Examination revealed a rather thin man of 42 who appeared chronically ill.

Abdomen: Musculature is thin, no definite point of tenderness, no masses or organs palpable.

Laboratory findings.—Laboratory work was done as follows: R. B. C., 4,520,000; hgb., 85%. W. B. C., 7,350; bands, 11; segments, 54; lymphs, 27; eosins, 4; monos, 4.

Urine: Normal.

Kahn: Negative.

Stools: Strongly positive for occult blood.

Gastric analysis: Not repeated inasmuch as he had had one done at the Scripps Clinic just 1 week before, and this showed no free HCl after the administration of histamine.

Blood sedimentation index: 20 mm in 60 minutes.

X-ray of the chest: No evidence of metastasis.

X-ray of the gastrointestinal tract, following barium meal, was reported as follows: Motor meal, distal ileum, cecum, ascending colon, head at the hepatic flexure; 6-hour residue, small amount in pyloric antrum. Cecum, normal. Esophagus, normal. Stomach, average size, high position, rugae very prominent. There is channeling as the barium enters the pars cardia. There is an irregular filling defect involving the pars media and cardia on the greater curvature side and anterior aspect which is brought out prominently in Trendelenburg position. No tenderness. There is reduced mobility of the fundus. Pars pylorica and duodenum show normal excursion. Cap well visualized, normal size and contour, fills and empties normally, not tender. Serial plates show very prominent rugae and a questionable filling defect, pars cardia. Impressions: 1. Carcinoma of stomach, pars media and pars cardia. 2. Hypertrophic gastritis.

Clinical record.—All evidence pointed toward a tumor growth of considerable size on the greater curvature near the fundus. Its position and evident size and probability of extensive metastases to neighboring glands made its operability very doubtful. Reasoning that it might be a lymphoma or other radiosensitive tumor and that in event of later operation preoperative radiation would be advisable, he was given 2,894.8 "R" units between 10–19–37 and 11–10–37. On 11–27–37 he was fluoroscoped following a barium meal, and although there was evidence of improvement, it was decided that the case warranted exploratory operation.

Operation.—On 12–10–37, under spinal procaine anesthesia, later supplemented with ether, the abdomen was opened through an upper left rectus incision. A mass about the size of a lemon was found on the greater curvature near the fundus. An area of infiltration surrounding it extended onto the posterior surface and down to the splenic pedicle. This mass was excised widely and the defect in the stomach closed. In removing the total area of infiltration, the splenic pedicle was so involved that it was necessary to do a splenectomy. No involved glands could be palpated. The shock of the operation was considerable; in fact, on two occasions cardiac massage through the abdominal wound, together with artificial respiration, had to be resorted to. He was given 500 cc of blood by the indirect method while on the table.

Pathologist's report.—Specimen consists of a portion of the stomach taken from the greater curvature near the cardiac end and measures approximately 9 cm in length. The wall is greatly thickened, very firm, and presents an ulcerated surface 1.5 cm in diameter on the mucosa. The ulcer does not penetrate more than 0.6 cm. On sectioning the stomach wall through this area the tissue is grayish, mottled with fat, and the entire wall of the stomach measures 2 cm in thickness. The serosal surface is covered with normal appearing fat. There is a distinct unpleasant odor to the fresh specimen. Microscopical: Sections show an anaplastic process in which there is marked overgrowth of the epithelial cells of the

glandular tissue. The cells are large, show hyperchromatism, and are infiltrating the muscularis. Many areas are degenerated, not only in the region of the ulcer described in the gross specimen, but deep in the substance of the stomach as well. The serosa is not invaded by the cells and the proximal and distal limits of the excision also appear free from tumor cells. Diagnosis: Adenocarcinoma, stomach.

Postoperative.—His convalescence, though stormy, was uneventful until on the eighth postoperative day when he became nauseated, vomited, and disrupted his wound. The anterior surface of the stomach was visible between the edges of the wound. No attempt at suture was made, but the wound edges were drawn as tightly together as possible with Murphy adhesive straps and a Scultitas bandage applied. The wound filled in by granulation. On 1–4–38 the healing was hastened by freshening the edges of the wound and suturing them with silver wire. These were removed on 1–14–38 and his convalescence after that was uneventful. Between 1–24–38 and 2–23–38 he received 2,679.6 "R" units of deep X-ray therapy.

He has gained weight slowly but steadily since being up and about following operation, and has no gastric complaints except that he has to limit the size of his meals—the cardiac portion of his stomach evidently not being able to store a full-sized meal. On 4–1–38 the X-ray of his chest was negative for metastases, and there was no clinical or physical evidence of same. He was invalided from the naval service on 5–12–38 and will report at regular intervals for further study.

CARBUNCLE OF KIDNEY

CASE REPORT WITH ATYPICAL SYMPTOMS

By Lieutenant Commander W. S. Sargent, Medical Corps, United States Navy

Renal suppuration is usually caused by the colon bacillus, staphylococcus, or streptococcus. Bacteria may be destroyed in, passed out through, or lodge in the kidney. The pyogenic cocci lodge primarily in the filter, that is in the cortex, and especially the glomeruli, and are apt to cause an acute infection with an alkaline urine and very few other urinary changes. The bilateral pyemic infection with its multiple minute abscesses mainly in the cortex and the unilateral carbuncle with its localized extensive tissue destruction as well as perinephric abscess are usually of coccal origin. The colon bacillus, like the tubercle bacillus, lodges primarily in the medulla and pelvis, particularly along the collecting tubules and usually causes a less acute infection with an acid urine loaded with pus. The infection may spread to the cortex by the lymphatics along the tubules and pyelonephritis or even pyonephrosis may result.

A great deal has been written regarding the routes of kidney infection. Hematogenous is the accepted common route and the primary focus is usually in the teeth, tonsils, skin, or mucosa of the nose, mouth, or bowels. The gonococcus is the only one that can climb, as it were, up the lumen. Ascending infection from the bladder only occurs if stasis or obstruction is present and then the likely route is up the lymphatics of the wall of the bladder and ureter to the capsule of the kidney and then to the blood stream and back to the kidney, rather than up the lumen. Spread from neighboring organs, as the

cecum along the lymphatics is hard to prove. Perirenal infection may come from the blood stream direct or from the cortex of the kidney along the cortical lymphatics and through the kidney capsule.

While a renal carbuncle may develop in pyelonephritis or kidney wounds it is most often secondary to a skin boil, carbuncle, or felon of recent or even remote date. In fact the skin lesion may have been forgotten or may have been insignificant. It is a severe, acute, unilateral and localized hematogenous infection of staphylococcic origin. It is a coalescence of multiple smaller abscesses and it becomes a solitary or conglomeration of larger and smaller areas of necrotic tissue separated from the rest of the kidney by a broad zone of granulation tissue. The relative freedom of the urine from pus is explained by the destruction of the tubules in the lesion itself and the intact condition of the glomerulotubular units at the periphery. It may interfere but little with renal function since it is circumscribed and walled off. It may spread to the perirenal tissue and then upwards, downwards, or toward the abdominal cavity.

Renal carbuncle may heal and not be recognized. It may be found at operation done for something else; or it may be found only at autopsy. It may be insidious in on-set and if mild may even simulate a tumor, especially if it is large and there is resistance and fixation on palpation. Severe cases may become very toxic or die

Most cases at the on-set have acute lumbar pain which may radiate to the testicle or thigh; the latter often simulating hip disease. On-set may be sudden with chills, sweats, weakness, prostration, malaise, sepsis, enlarged and tender kidney, and even intermittent fever. The white blood count and polymorphonuclears are increased. The urinalysis early may be nearly negative, but later may show staphylococci and some pus. Local tenderness over the kidney may be the only positive finding and the kidney may be fixed and not palpable. Perirenal extension is what usually gives the reflex symptoms.

It is often mistaken for influenza, infectious fevers, sepsis, pleurisy, Pott's disease and intra-abdominal conditions such as appendicitis, gall bladder disease, and ruptured ulcer.

Little help is obtained from the urine, X-rays, cystoscope, or ureteral catheter although in some cases a pyelogram may show distortion.

Signs and symptoms of sepsis and kidney involvement such as dull pain and costovertebral tenderness suggest staphylococcic infection of the kidney.

Mild cases get well without operation but if one suspects staphylococcic infection of the kidney in a case that is not doing well, it is better to explore. Many operative procedures have been tried such as open drainage, puncture and drainage, resection, partial excision, decapsulation, nephrotomy and nephrectomy. If there is also perinephric suppuration it is perhaps better to just drain and do

nephrectomy later, if necessary. Nephrotomy in early cases may suffice for some but on the whole nephrectomy is the operation of choice, and especially so in late cases Occasionally an emergency nephrectomy is necessary to save life.

Case Report

Adult male admitted to hospital September 28, 1937.

Chief complaint.—Pain in right upper abdomen.

Family history.—Negative.

Past history.—Appendectomy 14 years ago. Tonsillectomy 12 years ago. Lues about 15 years ago, and his Kahn is now negative. For 2 months he has been bothered off and on with back ache which he refers to the lumbar region on each side. It occurred more after working.

Present illness.—Began September 20. While he was painting, he became nauseated, but had no vomiting, colic, or diarrhea. Next morning he developed a pain in right upper abdomen which was also noted to run through to the back on the right side. The pain was dull, constant and made worse by any form of body movement. He thought he had developed stomach trouble so he went on a fruit diet.

No jaundice or colic occurred at any time. He has fever but no chills or sweats. There was no discomfort on urination, but he noted he had to urinate more frequently than formerly.

He had had a boil on the nose about 1 month before; in fact he has had boils quite frequently in the past.

Physical examination.—Skin was clear, it was free of infections, boils, and jaundice.

Head and neck: About one-half of his teeth were missing, and several of those remaining were diseased. The nose was then normal and his tonsils were gone.

Chest: Normal.

Abdomen: There was tenderness, rigidity, and rebound pain in the right upper abdomen extending around to the lumbar area. A mass was felt about the size of an orange at the gall bladder area. The rest of the physical examination was normal.

Temperature of 100.4° F.; pulse 90; respiration 20 upon admission. The urine showed no albumin; no red blood cells; sugar a trace, and quite a few white blood cells. The WBC was 17,500, with 3 juveniles, 17 band forms, and 67 segmented cells.

Operation.—Operation was done through the abdomen where it was found that the gall bladder, duodenum, hepatic flexure, and kidney were one adherent mass and upon being separated, odorless pus was found above the kidney and in its upper pole. A nephrectomy was done, drainage inserted, and abdomen closed.

Postoperative.—He ran a fever of 100° to 102° F. for 11 days and it then slowly returned to normal. Drainage was profuse for about a fortnight after which it gradually lessened and has now nearly stopped.

October 1, 1937. Urine showed pus but no blood.

October 4, 1937. Urine showed pus and occult blood.

October 9, 1937. Urine showed pus and occult blood.

His urine is now gradually clearing of pus. The laboratory report of the tissue was as follows: There is inflammation of the tissue involving the kidney substance; it varies in different areas from the acute with pus to the chronic with fibrous thickening and distortion of normal structure. There is no neoplasm or chronic granuloma.

NAVAL RESERVE

PROMOTIONS, SECOND QUARTER, 1938

Douglas B. Bell, 735 Bishop Street, Honolulu, T. H., promoted to lieutenant, MC–V (S), U. S. N. R., April 18, 1938.

Wyman Wilson Harden, c/o Florida National Bank Building, St. Petersburg, Fla., promoted to lieutenant, MC–V (G), U. S. N. R., May 2, 1938.

Frank Weger Konselmann, 3638 North Twenty-first Street, Philadelphia, Pa., promoted to lieutenant commander, MC–V (S), U. S. N. R., May 3, 1938.

Dar Delos Stofer, 1414 Professional Building, Kansas City, Mo., promoted to lieutenant commander, MC–V (S), U. S. N. R., May 3, 1938.

Ferdinand Christian Helwig, 4422 Mill Creek Parkway, Kansas City, Mo., promoted to lieutenant commander, MC–V (S), U. S. N. R., May 3, 1938.

Thomas Francis Welsh, 923 Boston Building, Salt Lake City, Utah, promoted to lieutenant, MC–V (S), U. S. N. R., June 7, 1938.

RESIGNATIONS, SECOND QUARTER, 1938

Clarence E. De La Chapelle, Bellevue Hospital, Third Medical Division, Twenty-sixth Street and First Avenue, New York City, N. Y., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted April 28, 1938.

Edward D. Hoedemaker, 706 Medical and Dental Building, Seattle, Wash., lieutenant, MC–V (S), U. S. N. R., resignation accepted April 28, 1938.

K. G. Cooper, Metropolitan Building, Denver, Colo., lieutenant, MC–V (S), U. S. N. R., resignation accepted April 28, 1938.

M. B. Wilson, 30 North Michigan Avenue, Chicago, Ill., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted April 28, 1938.

Oscar J. Raeder, 270 Commonwealth Avenue, Boston, Mass., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted April 28, 1938.

Asa Elmore Seeds, 2120 South Monroe Street, Spokane, Wash., lieutenant, junior grade, MC–V (S), U. S. N. R., resignation accepted June 2, 1938.

Oscar Oswald Miller, 2321 Alta Avenue, Louisville, Ky., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted June 2, 1938.

Roy Glen Spurling, 2601 Tophill Road, Louisville, Ky., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted June 2, 1938.

Nils O. Byland, Battle Creek Sanitarium, Battle Creek, Mich., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted June 25, 1938.

HONORABLE DISCHARGES, SECOND QUARTER, 1938

William Henry Collis, 603 Medico-Dental Building, Stockton, Calif., lieutenant, junior grade, MC–V (G), U. S. N. R., honorably discharged June 2, 1938.

HONORARY RETIRED LIST, SECOND QUARTER, 1938

William Curtis Newton, 2504 San Marcus Avenue, San Diego, Calif., commander, MC–V (G), U. S. N. R., transferred to honorary retired list June 15, 1938.

DEATHS, SECOND QUARTER, 1938

Jennings Mead King, 512 Hastings Street, Pittsburgh, Pa., lieutenant commander, MC–V (S), U. S. N. R., died April 9, 1938.

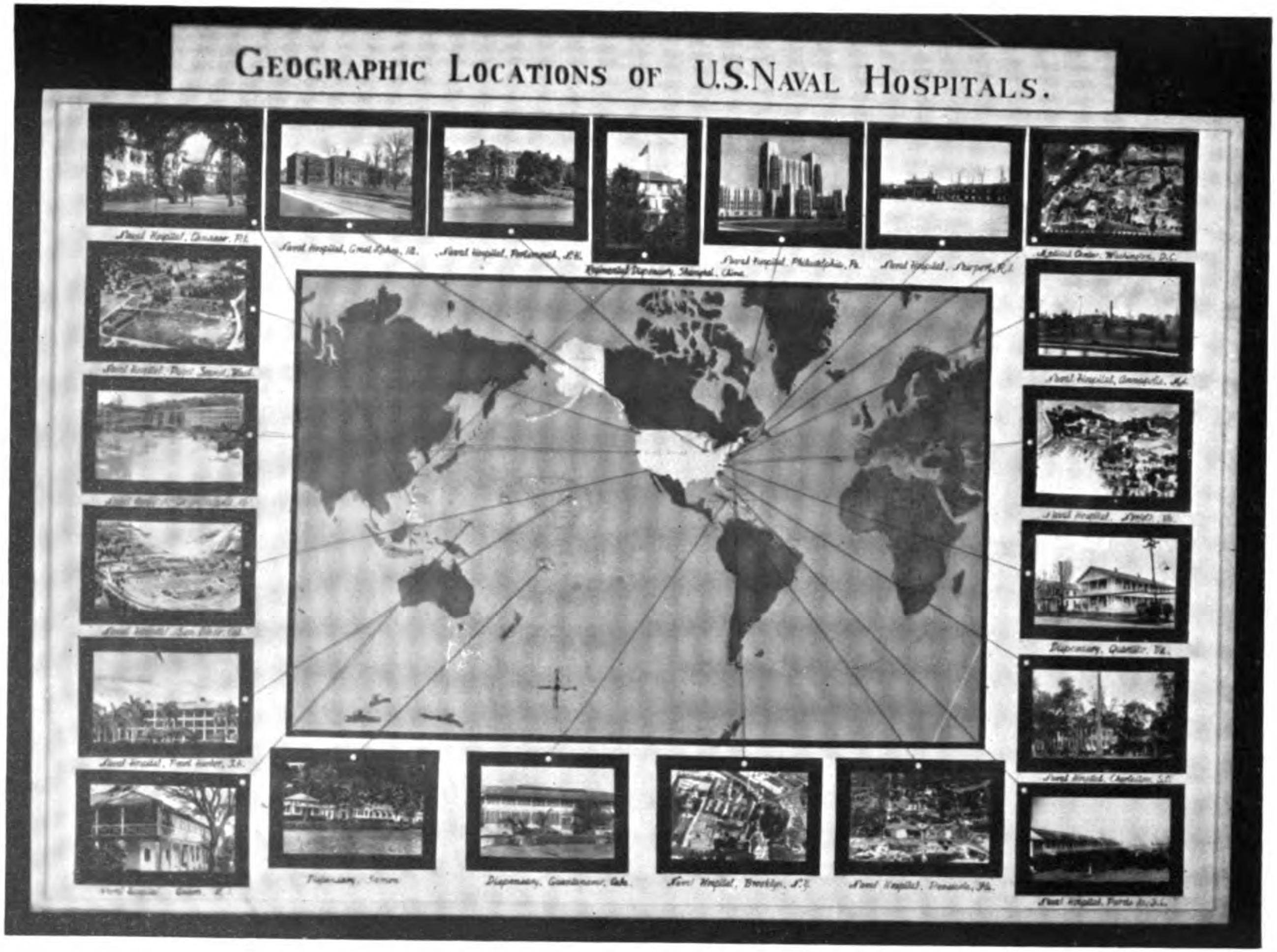

ILLUSTRATION FROM NAVY EXHIBIT.

NAVAL MEDICAL CENTER.

NOTES AND COMMENTS

THE NAVAL MEDICAL CENTER

A long step forward has been achieved in the selection of a site. On the fifth of July President Roosevelt, accompanied by Admiral Rossiter and Captain McIntire, visited the proposed site in Montgomery County, Maryland. They were so impressed with the beauty and suitability of the place that they were unanimous in their decision to build there.

Mr. Paul Cret is the consulting architect. Many bridges, buildings, and monuments designed by him are already regarded as among the most perfect in Washington. He visited the ground with Admiral Rossiter on the thirteenth of July and was delighted with its possibilities.

The site chosen is just outside Bethesda, on the Rockville pike, which is the main highway between Washington and the west. There are approximately 230 acres of slightly rolling ground, with a beautiful stand of first-growth timber on about one-third of it. For 2,300 feet it fronts on the Rockville pike, and it runs back to Rock Creek parkway and the Columbia Country Club. About 300 feet back from the pike is a gentle rise, on which the main hospital will be erected. Directly across from it, the Public Health Service is erecting the National Health Institute and the Cancer Research Institute. This appears to be the beginning of a considerable medical center in that neighborhood.

No matter who may be in the saddle when the structure is finally completed, the credit for its existence will go to Admiral Rossiter, our present Surgeon General, whose pet enterprise it has been for several years. Only through his persistent support and enthusiasm has it been possible to bring the project through the numerous rocks and shoals which blocked its path, to a point where its eventual completion seems assured. The accompanying illustration is appropriate, since it shows Admiral Rossiter viewing one of the proposed designs for the Naval Medical Center.

NAVY EXHIBIT AWARDED SPECIAL CITATION OF MERIT

Under the supervision of Capt. G. E. Thomas, Medical Corps, United States Navy, the Medical Department presented an exhibit at the annual meeting of the American Medical Association held in San Francisco in June 1938. This exhibit illustrated medical equip-

ment and practice in naval training schools, hospitals, aviation, submarine, and Marine Corps. The success of this display is evidenced by 6,940 visitors to the section during the 4-day session and the Association's award of a special citation of merit to the exhibit. The exhibit was not eligible to compete for a certificate since a similar exhibit won that distinction in 1937.

A three-wall section with 20 by 28 feet floor space was allotted to the Navy for exhibition purposes. The Making of a Blue Jacket was illustrated on one wall. This illustrated percentile selection of candidates, causes for rejection and demonstrated the number chosen for duty as seaman, hospital corpsmen or for preparatory schools, indicating reasons for choice in these various fields.

On the end wall were mounted photographs of airplane carriers and airplanes. There were also two parachute packs, one of the combat type and one of the transport type; on the ledge below was an open parachute of the combat type. The south wall showed photographs of the new X life preserver and the rescue dome for emergency fires or gas attacks on the surface of the water. Six Munson lungs showed the development of that mechanism from its origin to present stage. A large plaque of photographs gave internal and external views of the San Diego Naval Hospital and a large map tabulated to photographs showed the location and exterior views of various base hospitals of the United States Navy. On the ledge below this were exhibited a still for the manufacture of fresh water from salt water, the old life belt and new X life belt, and a regulation Munson lung for workable demonstration.

The central table held a scale model of the submarine rescue bell and on the floor before it was an auto-inflating, two-person life raft. On opposite sides of the table were two mannequins dressed in helmets, goggles, automatic life belts and flying suits; one showing summer equipment, the other the heavier winter paraphernalia. To one side, a third figure illustrated the one-piece aviation wading suit.

AUTOPSIES

A series of articles on the autopsy appeared in Hospitals, which is the official journal of the American Hospital Association, for June and July. These articles throw light on the subject from many angles that are not generally appreciated or understood. Since this periodical is not available to many medical officers of the Navy, some of the more important points are abstracted here by Capt. Lucius W. Johnson, Medical Corps, United States Navy.

The medicolegal autopsy may be defined as a postmortem examination which brings to light findings that may have a bearing upon proposed or actual civil litigation or upon a suspected or actual crimi-

nal or negligent act. The autopsy may be a routine hospital necropsy; if it yields information that has a bearing on a claim for insurance or compensation it assumes a medicolegal aspect.

No especial problems are presented by those cases in which information obtained by postmortem examination has a bearing upon civil litigation. Such information is not privileged. The medical examiner who acts in place of the coroner requires no permission from the next of kin for the performance of an autopsy. The physician should not assume the responsibility of signing a death certificate if called to a dead or dying person whom he has not previously attended. Such a case should be referred to the coroner.

The bitter criticism of physicians and hospitals which occasionally emanates from funeral directors results from a lack of understanding that the embalming profession presents numerous peculiar problems. Most physicians feel that it is merely a matter of draining the blood from the body and injecting a fixing solution into the arterial system. The funeral director must, of necessity, maintain a more spiritual attitude toward death and burial. He must prepare a body for the close inspection of perhaps hundreds of mourners. Destruction of the circulatory system by autopsy may make this impossible, and the wrath of the people may be visited upon the undertaker. Four postmortem activities of greatest importance which counteract the efforts to reproduce a lifelike appearance are impairment of circulation, rigor mortis, livor mortis, and discoloration from decomposition and gas formation. Time is often of greater importance in the production of these difficulties than even the most glaring mishandling. When bodies are to be shipped these changes become more pronounced. Most embalmers protest against the custom of putting a body into the ice box while waiting the convenience of the autopsy physician. This produces intravascular clotting and other changes which may make it impossible to do a good job of embalming.

Immediate injection of the arterial system is now done quite generally, the remainder of the preparation being done after the autopsy. The pathologist has certain objections to this. An autopsy goes beyond clinical diagnosis, and frequently reveals disease processes which were unsuspected before death. Bacteriological studies are impossible if embalming has been done. The characteristic color of organs is changed, and poisons may be disguised. The smell of cyanide poisoning and disturbances of pigment metabolism are hidden. Embalmed tissues may not react properly to the usual staining and fixing solutions.

Another aspect of the time element is that the funeral director and his men are often kept waiting for a considerable time for the body, and this also delays obtaining the death certificate.

Repair of the body after autopsy is an important matter. During the life of the patient, no careless procedure would be condoned. Death does not release the physician or the hospital from this obligation. The Y-shaped incision should be used. If the upper limbs of the Y are carried up to the shoulders it permits the neck and mandible to be examined without any local scarring. The scalp incision preparatory to removing the brain should never be made without considering the shape of the head and the amount of hair. In a scalp with insufficient hair to hide the incision, it should be far enough back so as to be invisible from the front. Use are in choice of suture material. Heavy cord is not suitable for the scalp or for incisions that cannot be entirely concealed. Number 0 cotton thread of the appropriate shade is better and can be used with intercuticular stitch to make an almost invisible suture.

The work of the embalmer is greatly facilitated if cannulas are inserted into the cut ends of the major arteries, with rubber tubes connected with them and leading to the outside of the body. The internal mammary arteries should be tied routinely, to prevent leakage of embalming fluid into the chest.

As a general rule, embalmers do not wish to have the viscera replaced. If an eye has been removed, a very satisfactory substitute can be made from paraffin. It is inserted from behind after the lids have been sutured with fine silk. After drying the inside of the thorax and abdomen, both cavities should be sprinkled with hardening compound. The cavities are then filled with cellucotton or crumpled clean paper towels.

Relations between the pathologist and the undertaker are rendered more cordial if a note accompanies each body upon which an autopsy has been performed. The note should apprise the undertaker of the efforts which have been made to cooperate with him and should urge him to communicate at once with the pathologist in the event that the repair has not been satisfactory. Courtesy and cooperation are usually reciprocated, and it is to the interest of every pathologist to establish cordial relations with the undertakers.

Religious aspects of the autopsy, if ignored, may cause the loss of many cases. The Jewish, Catholic, and Protestant rituals contain mandates which, if strictly observed, might be interpreted to forbid autopsies. But when the autopsies are meticulously performed by specialists who never overlook the interests of the dead and the survivors the injunction may be laid aside. There seems to be far greater prejudice among Jews than among other religions against autopsy. According to Jewish law, it takes 7 days to become clean after touching a body. Under the Jewish rabbinic law autopsies are permitted when they may be an honor to the deceased or when a human life can be saved thereby, but not for purely experimental

purposes. If it can be represented that another person in the hospital is suffering from the same disease as the deceased, and the cause of the disease and its treatment may be discovered through the autopsy, permission can very often be obtained. In nonsectarian hospitals the percentage of autopsies on Jewish bodies is very low, but in Jewish hospitals it may be high. The method of approach is important, and Jewish interns have a better appreciation of the psychology of their own people, so they are more successful in obtaining permission. The matter can be pictured to the relatives as a religious duty to the community, offering an opportunity to the individual, even in death, to further the well being of the people.

The Catholic religion does not prohibit autopsies. In fact there is considerable evidence of the interest and cooperation of the church in the matter of postmortem examination. St. Francis is quoted as feeling privileged to offer his body, both living and dying, a self-humiliation and self-sacrifice to be carried out after his death, and he begged his tutor to see that his body was given into the hands of the surgeons for dissection. This is an example which others can be urged to follow. In some Catholic hospitals the sisters play an important part in securing consent for autopsies.

Protestant religions provide no interdictions. Respect for the body is required, but its destructibility is acknowledged.

Pseudo-religious tabus are common. The superstitious fear of the body may influence the ignorant, causing a reluctance to permit a procedure which might be distasteful to the deceased. In medieval times dissection was limited to the bodies of criminals and this tradition may serve to suggest a reflection on the character of the deceased if autopsy be permitted. Most laymen still believe that an autopsy must be performed on every executed criminal. The great barriers are seen to be custom which wrongly presupposes interference with the ceremonial of interment; prejudicial tradition which associates autopsies with the stigma of crime; and sentiment, which is unable to disassociate the inanimate body from the vital personality of the departed.

Success in obtaining permission is directly proportional to the effort and intelligence put forth in trying to obtain them. It must be a carefully planned program in which the entire hospital personnel is educated to take a part. Three fundamental objectives are to be attained. First, the hospital must have the respect, confidence, and good will of the family of the deceased; second, every member of the hospital personnel must be convinced of the value and importance of autopsies, and they must all work together to obtain as many of them as possible; third, the actual solicitors must be well trained in the technique of making the request.

Whoever solicits the autopsy should have had contact with the family before the death of the patient and should be familiar with the

details of the case. He should be a loyal supporter of the autopsy, because a half-hearted appeal not backed by a firm conviction of the humanitarian and scientific value will fail. Telling of an autopsy upon the body of a noted physician or a member of his own family does much to convince the laity of its importance. In most hospitals the request is made by the interne, but he should have the backing and encouragement of his superiors. The idea of the importance of the autopsy should be sold to all internes when they first enter the hospital for training, and they should be carefully trained and coached in the technique of making the request. Each attempt should be followed by a report stating his success or failure.

Requesting an autopsy before death is justifiable and successful only under very rare circumstances such as long, chronic illness, unconsciousness of the patient, or the anticipated absence of the family at the end. The request is best made 15 to 30 minutes after the death. This gives the relatives time to recover somewhat from the shock, but will be before they leave the hospital. It should be made in a quiet room, at some distance from where the patient lies, and should be made direct to the next of kin, with as few others present as possible. It is always inadvisable to make the request in the presence of the dead or in the hospital corridor where there may be interruptions. There should be no appearance of haste or coercion. They may be asked if they would like to have an autopsy performed, stating that it is a courtesy offered by the hospital at no additional expense, causing very little additional delay, and usually gratefully accepted by relatives. It is important to present the subject as a favor to the family. In some instances the possibility of protection for other members of the family may be mentioned. The advisability of an autopsy as an aid in collecting insurance or compensation may be brought out, and it is well to mention the advantages of having the examination conducted by the unbiased hospital pathologist rather than by one selected by the insurance company. It is usually useless to speak of the advantage to humanity or the contribution to the advancement of science.

It is well to promise the family a report of some kind, but it is not well to send a copy of the official protocol because its unfamiliar terms confuse and may antagonize them. A report in the form of a simple letter in plain terms is better, but should not be routine because it may be used as the basis of a malpractice suit against the attending physician. Best of all is a tactful interview with the next of kin or the strong member of the family.

There are certain stock objections which one should be prepared to meet by having answers ready. Among the most common are: Disfiguration of the body; mutilation of the body; he has suffered enough; let someone else have it done; he would not have wanted it; this is not an unusual case; cancer is hopeless anyway; our religion does not per-

mit it; it will not bring him back; we do not care what he had; etc. The only fair way to obtain permission for autopsies is by fair, logical argument.

SURGICAL KNOTS[1]

Because of the disadvantages of absorbable sutures, there has been a noticeable trend back toward the nonabsorbable materials. Taylor was of the opinion that the occasional untied knot was the result of carelessness, and that all carefully tied square and surgeon's knots stayed tied. But, at the conclusion of this study, the startling feature seemed to be that so many knots stayed secure, that there were so few failures.

He devised an apparatus for testing knots, wet in various fluids or dry, with or without tension, and with or without friction. Plain gut, of the nonboilable type, when tied wet were found to be most undependable. A reliable knot could be tied only when dry. Square knots tied with chromic gut held much better than the plain gut. Surgeon's knots were much less dependable than the square knot. Silk and linen showed very few failures. The triple-throw knot, all turns tied square was found the most reliable.

Tests of the coefficient of friction were surprising. Silkworm gut, dermal, and the strong, hard twist of silk showed no increase of friction value after they had been soaked in serum. On the other hand, the coefficient of friction on linen and standard surgical silk increased two and three times when wet in serum. This means that a knot tightly tied will stay, but it also means that the increased friction may prevent pulling the knot tight.

Plain gut increased 80 percent in friction value when wet, and chromic gut was more than doubled. This is one reason why chromic gut knots are more reliable. Cutting the suture ends shorter than 5 mm for gut and 3 mm for linen or silk is a distinct hazard to the knot.

INFLUENZA[2]

This extensive report is based on correlated clinical and laboratory investigations made on epidemics of respiratory disease diagnosed as influenza during the years 1935–37.

Definite diagnosis is still quite impossible, clinically, in mild and sporadic cases. There is no single sign or symptom pathognomonic of epidemic influenza. However, the disease does present features which permit a probable clinical diagnosis during a major epidemic. The diagnostic problem is complicated by the common association of a bacterial infection with the virus disease. The fulminating pneu-

[1] Taylor, F. W., Annals of Surgery, 107: 458, March 1938.

[2] Report of the Medical Research Council; a study of epidemic influenza with special reference to the 1936–37 epidemic. Special Report Series, No. 228.

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monia seen in influenzal epidemics is almost certainly due to staphylococcus aureus associated with the influenzal virus. Moreover, recent experimental work has supported early observations that infection with the pneumococcus is particularly severe in cases that have recovered from influenza. Apparently the influenzal infection has no direct influence in the development of the pneumonia but it does lower the body resistance to pneumococcal infection during the post-influenzal period.

Positive diagnosis of influenza virus as the etiological factor in epidemics and as a factor in complicated and sporadic cases must depend upon laboratory identification of the virus. This is still a clumsy and costly procedure. Study of an epidemic is further complicated in that influenza is so erratic in its appearance, so capricious in attack and lasts for such a short period in any one locality. Recent advances in diagnostic methods, using mice and chick embryos, may simplify the problem somewhat.

However, the problem has been complicated in that recent investigations have demonstrated strains of the virus and they are not identical in reaction. The number of strains is still unknown and the degree of cross immunity developed by heterologous strains is under investigation. Some cross immunity is developed, but the virus-neutralizing potency of a serum for a homologous strain does not represent even a crude measure of that serum's virus-neutralizing potency for a heterologous strain.

This proof of the presence of a multiplicity of strains conferring an indeterminate cross immunity is of major importance. It makes experimental work prior to this discovery subject to critical review. It complicates the problem of prophylactic vaccination both as to evaluation of post results and as to developing a method of active immunization for the multiple strains. Fortunately there are benefits that may result from this discovery. The epidemiologist may be able to employ the identification of strains to advantage. Also, these strains may explain experiments in which vaccination failed to confer protection.

ANNUAL SESSION OF THE AMERICAN COLLEGE OF PHYSICIANS

The twenty-third annual session of the American College of Physicians will be held in New Orleans, with general headquarters at the municipal auditorium, March 27–31, 1939.

Dr. William J. Kerr, of San Francisco, is president of the college and will have charge of the program of general scientific sessions. Dr. John H. Musser, of New Orleans, has been appointed general chairman of the session and will be in charge of the program of clinics and demonstrations in the hospitals and medical schools and of the pro gram of round-table discussions to be conducted at the headquarters.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor, United States Naval Medical Bulletin,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

Surgical Treatment, by *James Peter Warbasse, M. D., F. A. C. S., special lecturer in the Long Island Medical College, formerly attending surgeon to the Methodist Episcopal and the Wyckoff Heights Hospitals, Brooklyn, N. Y., and Calvin Mason Smyth, Jr., B. S., M. D., F. A. C. S., assistant professor of surgery in the Univeristy of Pennsylvania Graduate School of Medicine, surgeon in chief to the Methodist Episcopal Hospital, Philadelphia, Pa., visiting surgeon to the Abington Memorial Hospital, Abington, Pa.* In three volumes with 2,486 illustrations on 2,237 figures, some in colors. Second edition. Thoroughly revised and reset. W. B. Saunders Co., Philadelphia and London, 1937. Cloth, $35 per set.

Twenty years ago James Peter Warbasse, of New York, gave to the practitioner and student of surgery a practical yet complete guide for the treatment of surgical disease. The work was dedicated to the surgical patient. Matured advice and practical treatment for nearly every surgical condition occurring under any circumstance were made readily accessible and understandable. The work rapidly earned an enviable reputation and the first edition exhausted several reprints. Now Dr. Warbasse, in collaboration with Calvin Mason Smyth, Jr., of the University of Pennsylvania Graduate School of Medicine, presents the second edition of Surgical Treatment. It is a pleasure to note that the general plan of the original work has been retained, although complete revision has been carefully carried out. The work is in three volumes, with a supplementary general index. Intracranial damage has been stressed in head injuries. The surgery of the thyroid gland has been completely rewritten, and the detail steps for subtotal thyroidectomy clearly pictured. Thoracic surgery is discussed briefly but in keeping with recent brilliant advances. Abdominal surgery includes the use of the Wangensteen siphonage. Cholecystectomy is considered the treatment of choice for acute cholecystitis but a rational basis for the time of intervention is outlined. The section on Bones and Joints is invaluable; at least one method has been given in detail for every known fracture. The subject of acute osteomyelitis is still considered urgent operative surgery and delayed surgical intervention a grave surgical sin. For

blood transfusion, the indirect citrate method is favored, although no mention is made of the late trend toward blood banking. The section on Anaesthesia has been revised, spinal anaesthesia is discussed in detail but without the force of mature judgment so richly displayed in other sections. On the whole the work is a safe, compact, masterly written treatise on the therapy of surgical disease.

SURGICAL DISEASES OF THE MOUTH AND JAWS, by *Earl Calvin Padgett, B. S., M. D., F. A. C. S., Associate Professor of Clinical Surgery, University of Kansas, Kansas City, Kans; Associate Professor of Oral Surgery, Kansas City Western Dental College, Kansas City, Mo.* 790 pages. 334 illustrations. W. B. Saunders Co., 1938. Philadelphia and London, 1938. Price, $10.

Here is a most attractive book on a subject of very great importance. When supplemented by the lectures of the author, it should prove a valuable guide for the members of his classes. For general uses, however, it presents certain defects which are, perhaps, inherent in first editions of text books. Certainly, they are unavoidable in a book which, like this, is designed to fit the needs of the dental student, the medical student, the general dentist, the physician, and the surgeon. To be acceptable to all these groups, a volume must contain complete elementary matter, as well as the most advanced technical details, really too much to ask of a single volume. As one result, many subjects are lightly touched upon which should be entirely ignored or else given sufficient space to allow for useful instruction.

Every duck hunter knows that, if you aim at a whole flock of ducks you will get none. To bring home the meat you must concentrate on a single bird. So the author's efforts to adapt his book to the needs of many unlike groups produces certain glaring defects. For instance, the instructions for extracting teeth, unnecessary for the dentist, are woefully inadequate for the physician or surgeon. After reading the paragraphs on phenol, mercurochrome, and Dakin's solution, one might reasonably conclude that the indications for one were the same as for either of the others. The method described for application of Dakin's solution was discarded by Carrell prior to our entry into the late war.

The bibliography is elaborate and quite complete so far as literature prior to 1920 is concerned, but references to publications within the last 10 years are relatively few. Much space is devoted to methods and appliances used in the nineteenth century which might better be given to developments of the last few years. One is led to suspect that the author is gifted with a bent toward historical research, for an enormous number of articles appearing in the last few years have apparently escaped his notice.

Despite these rather meticulous criticisms, an ambitious project has been accomplished in a praiseworthy manner, and this book will find a worthy place beside its few predecessors in this field.

Practical Proctology, by *Louis A. Buie, A. B., M. D., F. A. C. S., Head of Section on Proctology, the Mayo Clinic; Professor of Proctology, the Mayo Foundation, etc.* 493 pages. 152 illustrations. W. B. Saunders Co., Philadelphia, 1938. Price, $6.50.

There is such a plethora of useful, practical, and interesting statements in this volume that the reviewer can only record his general admiration of the work and then touch lightly on a few high spots.

Preoperative purgation is deprecated, and the opinion is fortified with substantial reasons. Sacral block anesthesia is preferred for rectal and anal surgery. General anesthesia is not considered suitable.

Certain types of hemorrhoids are definitely surgical, while others just as definitely are better treated by injection.

Thirty pages are devoted to chronic ulcerative colitis, of which disease the author has seen more than 2,000 cases. He discusses the various opinions on its etiology—that it is a deficiency state, a sequel of acute dysentery, a psychogenic affair, or a specific infection. His conclusion is that it probably represents a systemic infectious disease due to a streptococcus.

The chapter on malignant diseases records the cases of many patients with cancer in this region who have remained well for years after treatment.

Taken as a whole, the volume records the experience of the Mayo Clinic for the past 10 years in its department of proctology. It is a record of value to both specialist and general practitioner.

The Management of Fractures, Dislocations, and Sprains, by *John Albert Key, B. S., M. D., St. Louis, Mo., Clinical Professor of Orthopedic Surgery, Washington University School of Medicine, etc.*, and *H. Earle Conwell, M. D., F. A. C. S., Birmingham, Ala., Consulting Orthopedic Surgeon to the Tennessee Coal, Iron & Railroad Company, etc.* Second edition. 1,222 pages. 1,222 illustrations. The C. V. Mosby Co., St. Louis, 1937. Price, $12.50.

The authors have examined and tried the methods recommended by all surgeons, and indicate those which they have found best. They make little claim to originality, but their comment on the relative values of the various procedures is authoritative and practical. There are separate chapters on the workmen's compensation laws and medicolegal aspects of fractures. The chapter on fractures of the face and jaws is by Dr. James Barrett Brown, of St. Louis, a most competent expert.

This is a very complete work, somewhat smaller than an unabridged dictionary. It provides a useful guide for the doctor who treats fractures only occasionally, as well as for the specialist in this field.

Workbook in Elementary Diagnosis for Teaching Clinical History Recording and Physical Diagnosis, by *Logan Clendening, M. D., Professor of Clinical Medicine, University of Kansas.* C. V. Mosby Co., St. Louis, 1938. Price, $1.50.

A rather elementary text designed for students. It is written in notebook style, is sensible, practical, condensed, and should be found useful as a teaching aid. Of particular value are the numerous explanatory illustrations.

SYNOPSIS OF THE DIAGNOSIS OF THE ACUTE SURGICAL DISEASES OF THE ABDOMEN, by *John A. Hardy, B. Sc., M. D., F. A. C. S., El Paso, Tex.* 332 pages. 92 illvstrations. The C. V. Mosby Co., St. Louis, 1938. Price, $4.50.

This is a small book which can be carried in the coat pocket or in the doctor's bag. It is packed tight with an enormous amount of condensed, practical information. The author expresses the hope that the use of such a book will obviate the present tendency toward too much reliance on the laboratory and not enough on personal study and observation.

The book appears to be excellently arranged to achieve this object. It should be most useful to students preparing for examination, and also as a pocket companion for the general practitioner. With the increasing importance of family practice in the career of the naval medical officer, such a work should render valuable assistance to him.

HERNIA. ANATOMY, ETIOLOGY, SYMPTOMS, DIAGNOSIS, DIFFERENTIAL DIAGNOSIS, PROGNOSIS, AND THE OPERATIVE AND INJECTION TREATMENT, by *Leigh F. Watson, M. D., Member of Attending Staff of California Lutheran Hospital and Methodist Hospital of Southern California, Los Angeles.* Second edition, 558 pages. 281 illustrations. The C. V. Mosby Co. (St. Louis), 1938. Price, $7.50.

For many years, while the reviewer was actively engaged in surgery, the first edition of this book was one of those that he kept always on his desk for ready reference. The present volume presents many improvements and is even more valuable than its predecessor. It summarizes the trends in treatment of hernia in an interesting and authoritative manner.

Watson states that the use of fascia in herniotomy is already beginning to fade, because the recurrences have proved to be even greater in percentage than with classical methods. This is because the fascia often fails to live and is absorbed. Great disappointment is felt, because so much was expected of this repair with living fascia.

The injection method is spreading rapidly. More and more state compensation commissions and large industrial organizations are coming to require this method to be used instead of surgery. Reasons for this are that there is no time lost from labor; no anesthesia is required because the method is practically painless; a cure is available for many people who otherwise would never attempt it; there is no danger of shock or postoperative complications; the percentage of cures is greater than by operative methods.

The surgeon may well view with alarm the rise of a tide which today threatens his position as prima donna of the hospital troupe. It is the

rapidly spreading trend toward the injection treatment of hernia. Take away from the operating room the 1,300 herniotomies performed in the Navy during 1936 and consider how greatly the prestige of the surgeon would dwindle. Hemorrhoids and varicose veins have already been lost to the injectionists. Let us hope they do not discover an injection treatment for appendicitis, or the surgeon may retain but a shred of his former glory.

The author, who was formerly an enthusiastic operator for hernia, now considers that the injection treatment is indicated in 90 percent of cases. The following are favorable groups:

1. Industrial patients with small reducible hernia; especially those who cannot afford to take the time from work required by operation.
2. Aged and infirm patients, for whom operation carries increased risk and hazard.
3. Infants and children with small hernia, for whom operation is unsatisfactory owing to difficulties of postoperative care.
4. Patients with small reducible hernia who are fearful of an operation.
5. Patients with hernias of moderate size with the external inguinal ring measuring less than 3 cm in diameter. Larger than this, operation is preferable.
6. Moderately obese patients.
7. Patients whose hernias show a tendency to recur after operation. A few injections properly placed will overcome the weakness that might develop into a recurrence.
8. Patients with small postoperative hernias usually require only a few injections for a cure.
9. The injection is particularly suitable for small direct inguinal hernias because they have a higher postoperative recurrence than the indirect variety.
10. Femoral hernia, if the hernia can be reduced and kept reduced continuously during treatment.
11. Umbilical hernia, if small and completely reducible.
12. Epigastric and hypogastric hernias in the midline, if completely reducible.
13. Small reducible postoperative ventral hernias.

The injection treatment offers only a fair prognosis for the following groups:

1. Large reducible hernias associated with poor musculature, small inguinal rings, and the mass difficult to retain with a truss.
2. Small hernias with large rings.
3. Hernia complicated with diabetes, hyperthyroidism, tuberculosis, hypertension, prostatic hypertrophy, urethral strictures, and chronic cough.

The injection method is never indicated for the following groups:

1. All irreducible hernias—strangulated, incarcerated, or obstructed—and those with intrasaccular adhesions of omentum, intestine, or other viscera.
2. Hernias complicated with cancer, ascites, abdominal tumor, or severe hemophilia.
3. Large hernias with rings measuring more than 3 cm in diameter.
4. Sliding hernia, true traumatic hernia, and those associated with undescended testes.

Whatever may be our prejudices against a method which for so long has been the standby of the quack, no progressive surgeon can afford not to be informed on this subject. This book offers an excellent chance to study the relative advantages of the various methods of treatment of hernia.

HEMORRHOIDS, by *Marion C. Pruitt, M. D., L. R. C. P. and S. (Edinburgh), F. A. C. S., Atlanta, Ga.; President, American Proctologic Society; Associate in Surgery, Emory University School of Medicine, etc.* 164 pages, 78 illustrations, 7 in color. The C. V. Mosby Co., St. Louis, 1938. Price, $4

A very complete essay covering all phases of the subject. The chapters on treatment are especially noteworthy. They give full consideration to the advantages and disadvantages of each mode of treatment, and there is a final chapter on the choice of methods.

He considers that a scientific evaluation can come only from one having much experience in the use of all the different forms of treatment, while the enthusiasm of one who employs only one method is of little value. Surgery is stated to be preferable for hemorrhoids complicated by spasm of the sphincter, stricture, fissure, or fistula; for thrombosed external hemorrhoids, and for cases with combined external and internal hemorrhoids. Injection is best for simple internal hemorrhoids; for patients with hemophilia, purpura, or anemia from bleeding hemorrhoids; for patients with serious heart or kidney lesions; for old people, and for those who cannot afford the time off for operation.

The advantages of the injection treatment are that it is particularly painless; it is an office procedure, not requiring hospitalization or absence from work. But this method is suitable only for uncomplicated internal hemorrhoids. A cure by either method can be expected in 90 percent of cases.

PHYSICAL DIAGNOSIS, by *Don C. Sutton, M. S., M. D., Associate Professor of Medicine, Northwestern University School of Medicine; Attending Physician and Chairman of the Medical Division of the Cook County Hospital; Chief of the Cardiac Clinic, Cook County Hospital, Chicago; Attending Physician, the Evanston Hospital.* 495 pages. 298 illustrations and 8 color plates. The C. V. Mosby Co., St. Louis, 1937. Price, $5

A book written primarily to meet the needs of the student. The subject matter is condensed, clearly stated, and well illustrated. It will also be found of aid to the busy practitioner who desires to review the subject of physical diagnosis.

METHODS OF TREATMENT by *Logan Clendening, M. D., Clinical Professor of Medicine, Medical Department of the University of Kansas; Attending Physician, University of Kansas Hospitals; Consulting Physician, Kansas City General Hospital; Physician to St. Luke's Hospital, Kansas City, Mo.* Sixth edition. C. V. Mosby Co., St. Louis, 1937. Price, $10.

The fact that this book is now in its sixth edition since 1924 is not difficult to understand after one looks into its contents.

Within the compass of one volume the author has admirably succeeded in his aim of bringing together all therapeutic procedure of practical value to the clinician.

The contents are divided into two parts. Part I describes each procedure under the headings of drugs, diet, hydrotherapy, etc. Part II considers the application, the results to be expected, etc., under the heading of the various diseases.

New to this edition are discussions of protamine zinc insulin, scarlet fever streptococcus immunizing toxin, staphylococcus toxoid, pertussis vaccine, cyclopropane anesthesia, mandelic acid, sulfanilamide, and treatment of delirium tremens.

THE ROLE OF CHEMIOTAXIS IN BONE GROWTH, by *A. P. Bertwistle, M. B., Ch. B., F. R. C. S. (Edinburgh)*. (53 pages. 32 illustrations.) Henry Kimpton (London) 1937. Price 8s.6d.

This speculative monograph is devoted to the thesis that new bone formation is not a function of the periosteum, but occurs wherever a calcium formation is in contact with young connective tissue, particularly young blood vessels. On this basis he explains healing of fractures and of bone tuberculosis, myositis ossificatans, calcification in cysts and in the walls of blood vessels.

THE INJECTION TREATMENT OF HERNIA AND HYDROCELE, by *Lawrence Goldbacher, M. D., Philadelphia, formerly Chief of the Hernia Clinic, Shelter for the Homeless; Lieutenant Commander, U. S. N. R., etc.* (189 pages. 58 illustrations.) L. Aubrook & Co., Philadelphia, 1938. Price, $5.75.

This month the desk is piled high with new books on the injection treatment of various disorders which have been, for generations, the proving ground for the surgeon. Varicose veins, hemorrhoids, hernias, hydroceles, and bursas are now being attacked by this simpler and allegedly safer technic. At the same time we read (Journ. Amer. Med. Assoc., 110: 1,812, May 28, 1938) a report of two fatalities following injection treatment of hernia, one patient coming from an irregular practitioner and the other from a regular physician specializing in the injection treatment.

Without doubt, there will be an enormous increase in the number of cases of hernia and hydrocele treated by injection in the next few years, just as there has been a great number of cases of varicose veins and hemorrhoids injected during the years since 1930. This treatment offers a considerable saving in money and in sick days, besides making curative measures possible at the smallest sick bays.

In the Medical Corps of the Navy we cannot close our eyes to this strong trend toward the injection treatment, nor can we ignore the fact that it is based on successful treatment of hundreds of thousands of cases in the hands of practitioners of average ability. Therefore it is important that we study the subject thoroughly, to determine whether or not it suits the needs of the service.

Dr. Goldbacher's book will be found a useful primer for beginning this study. It is quite elementary in its description of hernia and the treatment by injection. He prefers a solution of 5 percent phenol in corn oil, with ethyl aminobenzoate added for its local anesthetic action.

In hydrocele, he claims several advantages for injection treatment over operation. It is simple, safe, and painless, an office operation which causes no loss of time to the patient.

Bursitis in the olecranon and prepatellar regions has also been successfully treated by injection, and Dr. Goldbacher believes it to be superior to operation.

EVERYDAY FIRST AID, by *Walter Frank Cobb, M. D., Medical Examiner, Department of Hygiene, College of the City of New York; Special Instructor, American Red Cross First Aid Service.* D. Appleton-Century Co., Inc., New York. Price, $1.50.

An interesting and readable monograph for the layman, utilizing concrete examples of accidents clipped from the daily news as chapter leads. It is full of sound advice, which is well emphasized and supported by excellent diagrams, covering all the common emergencies.

While it is by no means a manual of first-aid treatment, it is well indexed and could be used as such or as a basis for lectures to laymen on first aid. It is unique among first-aid literature because of the simple, flowing, conversational style.

INJECTION TREATMENT OF HERNIA, by *Carl O. Rice, M. D., F. A. C. S., Instructor in Surgery, University of Minnesota School of Medicine; Surgeon in Charge of the Surgical Out-Patient Department of the Minneapolis General Hospital, etc. With the assistance and cooperation of Hamlin Mattison, M. D.* 83 illustrations. 250 pages. F. A. Davis Co. (Philadelphia) 1937. Price $4.50.

Before the days of aseptic surgery, the injection treatment of hernia enjoyed a deserved popularity. With the advent of modern surgical methods it was relegated to the quacks and charlatans. Recently there has been an increased interest in the injection treatment, and

it has been found to compare very favorably with surgery, both in safety and permanency of cure.

This book gives a very complete exposition of the various methods and solutions used, the technic, indications and contraindications, complications and sequelae, and the results. There is also a chapter on the medicolegal aspects of hernia and the workmen's compensation laws of the several States. The author recommends the injection treatment as a supplement to our surgical armamentarium for those cases in which operation is contraindicated and in those cases which are suitable for this type of treatment. His arguments are based on more than 6,000 cases of hernia treated by injection. Any surgeon who is not completely satisfied with his results in the operative treatment will find this book a stimulant and a challenge.

INJECTION TREATMENT OF VARICOSE VEINS AND HEMORRHOIDS, by *H. O. McPheeters, M. D., F. A. C. S., formerly Director of the Varicose Vein and Ulcer Clinic, Minneapolis General Hospital, etc.*, and *James Kerr Anderson, M. D., F. A. C. S., Instructor in Surgery, University of Minnesota School of Medicine, etc.* 299 pages. 82 illustrations. F. A. Davis Co., Philadelphia, 1938. Price, $4.50.

The advantages of injection treatment over operation for suitable cases of varicose veins and hemorrhoids are now so generally recognized that it seems hardly necessary to comment on them. But here is a book by one of the pioneers in this method, giving the benefits of his experience in an enormous number of cases, which is really worth while.

Indications, contraindications, anatomy, theory, and technic are fully discussed, and opinions are stated which can be accepted as coming from the very highest authority.

No medical officer nowadays can afford to remain ignorant of the rapid advances that are being made in the injection treatment of many disorders. Conditions that only a short time ago were treated by major surgical operation are now being treated as office cases, safely, simply, and without sick days. Here is one of the best books available for study within its field.

THE NEW INTERNATIONAL CLINICS, *edited by George Morris Piersol, M. D.* Volume I, 1938. J. B. Lippincott Co., Philadelphia. Price $3.

This, volume 1 of the new series (old forty-eighth), contains 25 articles by leading authorities on a wide variety of subjects.

The first paper is by Warfield T. Longcope on Some Observations on the Course and Outcome of Hemorrhagic Nephritis. In summarizing, he states in part: "Our studies of hemorrhagic Bright's disease show that there is one form of this condition which is so closely related both in its onset and in its progress to infections caused by hemolytic streptococci that it is difficult to escape the conclusion that

this organism is either directly or indirectly the cause, though probably not the sole cause, of the disease."

Sulphanilamide in small doses was administered to a number of patients in this group and it is remarked "There is no indication that it had produced any harmful action upon the kidneys themselves. Indeed convalescence and symptomatic recovery has taken place quite rapidly in these patients. It can only be said that our results, so far, encourage us to continue the use of the drug cautiously in the patients who can be shown to have an active infection due to hemolytic streptococci."

William H. Robey has an article on Recognition and Treatment of Some Acute Cardiac Accidents.

Samuel Weiss discusses Medical and Surgical Jaundice With a Consideration of Liver Deaths.

Frederick Christopher contributes a paper on the Treatment of Wounds.

Damasco de Rivas writes on Treatment of Amebic Dysentery by Means of Intracolonic Heat.

In addition to these and many other interesting papers, A. Cantarow, in the section on Review of Medical Progress, summarizes recent contributions concerning the subject of biliary stasis and decompression.

TREATMENT BY DIET, by *Clifford J. Barborka, B. S., M. S., M. D., D. Sc., F. A. C. P., Department of Medicine, Northwestern University Medical School, Chicago; formerly Consulting Physician, the Mayo Clinic.* Illustrated. Third edition, revised. J. B. Lippincott Co., Philadelphia, London, and Montreal, 1937. Price $5.

A volume of distinct value to the clinician and also to the dietitian. It teaches the principles of nutrition in their relation to the practice of medicine, so that the physician may use these principles to formulate his own dietary treatment.

The author rightly urges that the various diets outlined not be used as a stock or printed list for a particular disease applied to all patients afflicted with the disease, irrespective of the particular needs of the individual patient.

The book is divided into five parts:

I. Diet in health. This part gives a brief account of the principal foodstuffs and their place in diet. There are tables of food values of certain foods about which a working knowledge is of importance.

II. The application of diet therapy discusses the method of calculating all the diets presented, conception of servings to be used or indicated in the diets outlined, with a list of suggested substitutions.

III. Diet in disease, attempts briefly to show the practical application of all the foregoing principles to the problem of selecting the food needed for the treatment of each individual case.

IV. Routine hospital diets. Six diets are suggested to meet the various needs of the average hospital. Special methods of feeding are included.

V. An appendix of tables, recipes, and other matters of value.

A comprehensive bibliography completes the work.

Athletic Injuries, Prevention, Diagnosis, and Treatment, by *Augustus Thorndike, Jr., M. D., Surgeon in the Department of Hygiene, Harvard University; Assistant in Surgery, Harvard Medical School; Associate Surgeon, Children's Hospital, Boston, Mass.* 200 pages with 104 illustrations. Lea & Febiger, Philadelphia. Price, $3.

An admirable monograph on the care of the athlete, covering more material than is suggested in the title, is the above. Part I brings up to date, in compact and easily understood form, the present status of knowledge concerning the changes in the muscular, cardio-vascular, and respiratory systems during the process of training. Modern theories of muscle action and fatigue, and the causation relation of the latter to injury, are presented. Part II covers the more common types of athletic injuries, their pathology, diagnosis, and treatment. Part III covers in detail the regional injuries incurred and uniquely treats sprains as injuries to individual anatomical ligaments. Mechanical methods of prevention and treatment of most of the injuries are shown in detail in the photographs and line drawings.

It should be invaluable to coaches, trainers, and physicians concerned with athletics and the care of the athlete, and might well be a valuable addition to the library of the military surgeon.

Diseases of the Nose, Throat, and Ear, Medical and Surgical, by *William Lincoln Ballenger, M. D., F. A. C. S., late Professor of Otology, Rhinology, and Laryngology, College of Medicine, University of Illinois, Chicago, Ill., etc.*, and *Howard Charles Ballenger, M. D., F. A. C. S., Assistant Professor of Otolaryngology, Northwestern University School of Medicine, Chicago; Surgeon, Depart-mrnt of Otolaryngology, Evanston, Hospital, Evanston, Ill.; Fellow of the American Laryngological, Rhinological, and Otological Society; Fellow of the American Academy of Ophthalmology and Otolaryngology.* Seventh edition, thoroughly revised. Octavo, 1,030 pages, illustrated with 576 engravings and 30 color plates. (Lea & Febiger, Philadelphia, Pa., 1938.) Cloth. Price $11, net.

This is the seventh edition of this standard work on ear, nose, and throat disease. It has been completely revised and now is the most up-to-date textbook on otorhinolaryngology written in this country.

There is one chapter devoted to the discussion and treatment of petrositis, which is commanding so much discussion among auralogists. It is interesting to note that the authors of this text differentiate between osteomyelitis and osteitis of the temporal bone, showing that the text has incorporated the most recent ideas regarding the pathology of the petrous pyramid.

The chapters devoted to Bronchoscopy, Esophagoscopy, and Gastroscopy have been written by Drs. Chevalier Jackson and Gabriel

Tucker. These chapters are general in scope. There is a bibliography appended to these chapters giving references to the subject matter of this branch of laryngology in much more detail. The bronchoscopist would prefer more extensive and detail writing for reference than this text affords.

The chapter devoted to the diagnosis of lateral sinus thrombosis is concise and the chapter on treating this disorder incorporates all the latest views, such as feasibility of ligation or resection of the jugular vein.

PRACTICAL OTOLOGY, RHINOLOGY, AND LARYNGOLOGY, by *Col. Adam Edward Schlanser, United States Army Medical Corps.* (313 pages.) Lea & Febiger, Philadelphia, Pa., 1938. Price $4.50.

This is an excellent book, written by a medical officer of the United States Army, upon the treatment of ear, nose, and throat diseases. It is concise, clear, and will be of value especially to interns in the ear, nose, and throat services and to medical officers aboard ship and on independent duty in handling diseases in this field of medicine.

This book is not intended to replace the more extensive tomes in otorhinolaryngology for the specialist in this field. Anatomy, physiology, and detailed symptomatology have been omitted in this book. It deals with the practical handling of the routine cases of ear, nose, and throat disorders.

THE DIVISION OF PREVENTIVE MEDICINE

Commander C. S. STEPHENSON, Medical Corps, United States Navy, in charge

TOXIC EFFECTS OF ARSENICAL COMPOUNDS

AS ADMINISTERED IN THE UNITED STATES NAVY IN 1937 WITH SPECIAL REFERENCE TO ARSENICAL DERMATITIS

By Commander C. S. STEPHENSON, Medical Corps, United States Navy, and E. H. WINGO, Chief Pharmacist's Mate, United States Navy

For the past 13 years medical officers of the Navy have been required to submit to the Bureau of Medicine and Surgery monthly reports of the number of doses of arsenicals administered and the reactions therefrom. This information has been compiled and published in the following United States Naval Medical Bulletins: September 1925, January 1927, January 1929, July 1930, October 1931, October 1932, April 1933, October 1933, October 1934, January 1935, October 1935, January 1936, October 1936, January 1937, October 1937, and January 1938.

In table 1 are shown the number of doses of each arsenical administered in the year 1937, the reported reactions which occurred, and similar data for the 13-year period 1925–37. It is noted that in 1937 there was 1 reaction to 2,194 doses and 1 death to 107,533 doses. For the 13-year period 1925–37 there was 1 reaction to 1,346 doses and 1 death to 30,460 doses.

TABLE 1.—*Arsenicals, U. S. Navy, 1937 and 1925–37—type of drug, reaction, and ratio of doses to reactions*

	Number of doses administered	Reactions				Ratio of reactions to doses 1 to—	Ratio of deaths to doses 1 to—
		Mild	Severe	Fatal	Total		
Year 1937:							
Arsphenamine	1, 846	0	0	0	0	0	0
Bismarsen	531	0	0	0	0	0	0
Mapharsen	10, 660	0	1	0	1	10, 660	0
Neoarsphenamine	85, 760	36	9	1	46	1, 864	85, 760
Silver arsphenamine	10	0	0	0	0	0	0
Sulpharsphenamine	1, 507	1	0	0	1	1, 507	0
Tryparsamide	7, 219	1	0	0	1	7, 219	0
Total	107, 533	38	10	1	49	2, 194	107, 533
13-year period 1925–37:							
Acetarsone [1]	945	0	0	0	0	0	0
Arsphenamine	41, 558	27	14	1	42	989	41, 558
Bismarsen [2]	1, 890	0	0	0	0	0	0
Mapharsen [3]	13, 535	0	1	0	1	13, 535	0
Neoarsphenamine	1, 172, 843	580	278	42	900	1, 303	27, 925
Silver arsphenamine [4]	586	0	1	0	1	586	0
Sulpharsphenamine	26, 544	17	8	0	25	1, 062	0
Tryparsamide	51, 893	3	1	0	4	12, 973	0
Total	1, 309, 794	627	303	43	973	1, 346	30, 460

[1] First administered during the year 1932.
[2] First administered during the year 1929.
[3] First administered during the year 1935.
[4] First administered during the year 1931.

TABLE 2.—*Arsenical reactions, U. S. Navy, 1937*

Classification	Cases	Deaths	Classification	Cases	Deaths
Arsenical dermatitis	26	0	Jarisch-Herxheimer	1	0
Vasomotor phenomena	13	0	Liver damage (jaundice)	1	0
Blood dyscrasias	3	0	Optic neuritis	1	0
Gastrointestinal	2	0			
Hemorrhagic encephalitis	2	1	Total	49	1

From table 2 it may be seen that the most frequent reactions are those that are classified as arsenical dermatitis and vasomotor phenomena. Dermatitis in some form was observed in 53.06 percent of the cases. In 1936 dermatitis in some form was observed in 44.74 percent of the cases.

TABLE 3.—*Proportion of reactions of various types, 1929–37*

Classification	Number of reactions	Percent of total reactions
Vasomotor phenomena	326	44.23
Arsenical dermatitis	261	35.41
Blood dyscrasias	34	4.61
Liver damage	26	3.53
Table reactions	26	3.53
Reactions of minor importance	17	2.31
Jarisch-Herxheimer	17	2.31
Gastrointestinal	13	1.76
Hemorrhagic encephalitis	8	1.08
Optic neuritis	3	.41
Arsenical neuritis	2	.27
Acute renal damage	1	.14
Border line, hemorrhagic encephalitis	1	.14
Liver damage (doubtful reaction)	1	.14
Vascular damage (probable adrenal hemorrhage)	1	.14
Total	737	100.00

In this article will appear a brief summary of the clinical history of each of the 26 cases of arsenical dermatitis.

ARSENICAL DERMATITIS

The 26 cases of arsenical dermatitis reported in 1937 were classified as 17 mild and 9 severe reactions. The type of lesion was exfoliative in 10 instances, erythematous in 10, macular in 4, maculopapular in 1, and fixed exanthem in 1.

MILD REACTIONS

The 17 mild reactions occurred after the following number of injections: 3 after the second injection, 8 after the third, 2 after the twentieth, and 1 each after the fourth, nineteenth, twenty-second, and fortieth.

The interval between injection and appearance of symptoms varied from 2 hours to 12 days.

The length of time required for complete recovery varied from 24 hours to 124 days.

A brief history of each case is cited.

NEOARSPHENAMINE

(*1—1937.*) One month following exposure to infection on January 6, 1937, this patient developed a lesion on the prepuce which was positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

The patient was given 0.3 gram injections of neoarsphenamine on February 9 and 12, 1937, and 4 days after the last injection of neoarsphenamine complained of general malaise. Examination showed a well-developed morbilliform rash over the entire body and slight edema of the face. He was given 2 grams of sodium thiosulphate intravenously at 9 a. m. and 1 gram intravenously at 8 p. m. The following morning (Feb. 17) the patient complained of malaise and slight pruritis over the abdomen and back. Temperature 100° F. The skin eruption is clearing rapidly. He received 1 gram of sodium thiosulphate intravenously, daily for 4 days. Recovery in 5 days.

(*2—1937.*) Following exposure to infection on March 21, 1937, this patient developed a small punched-out lesion on the meatus extending inside the urethra. A dark-field examination of the lesion was positive for *Treponema pallidum*. Repeated Kahn blood tests were negative.

Arsenical treatment began April 20, 1937, with a 0.3 gram injection of neoarsphenamine, followed by 0.4 gram on April 24, and 0.6 gram on April 27. Two hours after the last injection, and after eating the noon meal, the patient complained of headache and nausea. About 8 hours later his temperature was 103° F.; pulse, 100; and respirations, 20. The following day his temperature was normal in the morning and 101° F. in the afternoon. He was given 1 gram of sodium thiosulphate intravenously. On April 29, 2 days after the last injection of neoarsphenamine, an erythematous rash appeared on the hands and feet. The sclerae were injected and the patient complained of headache. Temperature was 103° F. in the morning and 104° F. at 7 p. m. He was given 1 gram of sodium thiosulphate intravenously, followed by one-half cubic centimeter of adrenalin, every 3 hours during the day and 25 cubic centimeters of 50 percent solution of glucose intravenously morning and afternoon. The above treatment was continued and the clinical picture remained about the same until after the fourth day, when the erythematous rash became generalized over the trunk and extremities and the temperature rose to 105° F. Alcohol baths and cool enemata were given and the temperature dropped to 104° F. within an hour. The patient's general condition was good and his temperature gradually returned to normal. Recovery in 12 days.

(*3—1937.*) Two weeks after exposure to infection on April 22, 1937, this patient developed a typical chancre on the penis which was positive for *Treponema pallidum*.

He was given a 0.3 gram injection of neoarsphenamine on May 6, 1937, and 0.5 gram injections on May 12 and 18. He received 0.13 gram injections of bismuth salicylate on May 6 and 13.

The patient stated that he felt nauseated about 4 hours after the last injection of neoarsphenamine on May 18 and was ill during the next day. He failed to report this condition until the evening of May 20, at which time his body was covered with a fine macular rash and he complained of chills and severe headache and backache. Temperature, 102.8° F.; pulse, 110; and respirations, 26.

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He was given 1 gram of sodium thiosulphate intravenously on May 20 and 21, after which the rash disappeared and his temperature gradually returned to normal. Recovery in 5 days.

(*4—1937.*) After several exposures to infection this patient developed a lesion on the penis which was positive for *Treponema pallidum.* A Kahn blood test was also positive.

He was given a 0.3 gram injection of neoarsphenamine on May 12 and a 0.45 gram injection on May 18, 1937, and 2 injections of bismuth salicylate as concurrent treatment. About 3 hours after the last injection of neoarsphenamine the patient complained of headache, chills, fever, and vomiting. He was given 15 minims of adrenalin, and 15 minutes later 1 gram of sodium thiosulphate intravenously. The following morning he complained of weakness and was given 1 gram of sodium thiosulphate intravenously. Temperature, 102° F.; pulse, 110; and respirations, 20.

Two days after the last injection of neoarsphenamine, a macular rash appeared over the trunk and extremities; 1 gram of sodium thiosulphate was given intravenously. Temperature, 100° F.; pulse, 96; and respirations, 20. The following morning the rash became intense but the patient felt much better. His temperature returned to normal and the rash gradually disappeared. Recovery within 8 days.

(*5—1937.*) This patient was exposed to infection on June 22, 1937. Nine days after exposure several lesions developed on the glans penis and scrotum. Dark-field examinations of the lesions were positive for *Treponema pallidum.*

He was given a 0.3 gram injection of neoarsphenamine on July 1 and 0.45 gram injections on July 5 and 8, 1937. Five hours after the last injection the patient's temperature was 101° F. He developed nausea and vomiting and complained of headache and backache. Two hours later his temperature was 104° F. and he was given 1 gram of sodium thiosulphate intravenously. Sore throat developed 2 days after the last injection of neoarsphenamine. Examination revealed several red spots of various sizes on the abdomen and arms. Appearance of the spots suggested an early secondary syphilitic skin rash. One gram of sodium thiosulphate was given intravenously. The skin condition developed into a macular rash involving the abdomen and arms. Recovery in 5 days.

(*6—1937.*) This patient was given a diagnosis of syphilis because of secondary skin eruption, generalized adenopathy, repeated 4-plus Kahn blood tests, and history of a chancroid on the penis, May 5, 1937.

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on June 25, 1937, followed by a 0.45 gram injection on June 29, and a 0.6 gram injection on July 6. Two hours after the last injection the patient complained of headache and nausea. His temperature rose to 103° F. within 6 hours. Examination showed an erythematous rash over the entire body, marked redness and itching of the hands and feet and swollen eyes. He was given 1 gram of sodium thiosulphate intravenously daily for 5 days. Recovery in 14 days.

(*7 and 8—1937.*) This patient experienced 2 mild arsenical dermatitis reactions during the second course of arsenical treatment. He was given a diagnosis of syphilis because of generalized adenopathy, a faint secondary skin rash, repeated 4-plus Kahn blood tests, and a healed indurated ulcer on the penis.

From March 5 to May 6, 1937, he received 10 injections of neoarsphenamine, a total of 5.4 grams, and 10 intramuscular injections of bismuth salicylate were given as concurrent treatment. The second course of arsenical treatment began with a 0.3 gram injection of neoarsphenamine on June 12, followed by a 0.45 gram injection on June 19, and 0.6 gram injections on June 26, July 6, 10, 17, 24, 31, and August 7. Eleven days after the last injection of neoarsphenamine the patient returned from leave complaining of a body rash, and examination revealed

an erythematous rash over the neck, chest, abdomen, and extensor surfaces of the arms and hands. The skin condition was suggestive but not conclusive of arsenical poisoning and cleared promptly within 2 days.

On August 21, 1937, he was given a 0.6 gram injection of neoarsphenamine. Twenty-four hours later there was a recurrence of the erythematous rash which was readily controlled everywhere except on dorsum of the hands. A change to a dermatophytic condition with extensive vesicle formation was noted. There was a moderate degree of edamatous swelling and considerable itching. He was given 1 gram of sodium thiosulphate intravenously on August 23, 24, 25, and 27. Recovery in 12 days.

(*9—1937.*) This patient was exposed to infection on July 16, 1937, and 15 days later a penile lesion was positive for *Treponema pallidum.* Repeated Kahn blood tests were 4-plus.

He was given a 0.3 gram injection of neoarsphenamine on August 3, 1937, and a 0.6 gram injection on August 10. Six hours after the last injection the patient complained of chills and general aching. His temperature was 104° F. during the evening and returned to normal the following morning. Two days after the last injection of neoarsphenamine an erythematous rash appeared over the abdomen and thorax; the patient complained of sore throat; and the face was slightly swollen. He was given 1 gram of sodium thiosulphate intravenously. His temperature was 101° F. during the evenings and gradually returned to normal within 4 days. On August 17, 1937, he was given a 0.6 gram injection of neoarsphenamine to observe the reaction. About 5 hours later he vomited, had a rise in temperature, and flushed skin. He was given 1 gram of sodium thiosulphate intravenously. The skin condition cleared rapidly and his temperature was normal 3 days later. Recovery in 11 days.

(*10—1937.*) One month following exposure to infection this patient developed a penile lesion and generalized lymphadenopathy. A darkfield examination of the lesion was positive for *Treponema pallidum.*

He was given a 0.3 gram injection of neoarsphenamine on August 29, 1937, and a 0.45 gram injection on September 3. Six hours after the last injection the patient developed a mild vasomotor phenomena reaction, with recovery within 44 hours. This reaction will be described in a later bulletin.

Arsenical treatment was continued and he was given a 0.45 gram injection of neoarsphenamine on September 7. Five and one-half hours later he complained of headache, and was restless and nervous. Examination showed injected conjunctivae and a generalized itching erythematous macular rash which persisted for 12 hours. He was given 1 gram of sodium thiosulphate intravenously on September 7 and 8. Symptoms disappeared within 24 hours.

(*11—1937.*) This patient was exposed to infection on July 15, 1937, and 1 month later developed a penile lesion which was positive for *Treponema pallidum.* A Kahn blood test was 4-plus.

He was given a 0.3 gram injection of neoarsphenamine on August 17, a 0.45 gram injection on August 20, and a 0.6 gram injection on August 24. On each of the above dates he received a 0.13 gram intramuscular injection of bismuth salicylate.

On the morning of August 24, before receiving the injection of neoarsphenamine, the patient complained of fever and sore throat. Physical examination was negative, and his temperature was normal. About 8 hours after the injection of neoarsphenamine his temperature was 104° F.; pulse, 110; and respirations, 20. He vomited following the administration of 1½ ounces of magnesium sulphate. The following morning he complained of headache. His temperature was 101° F., but rose to 104.4° F. in the afternoon. Physical examination was negative other than a very red throat. Three days after the last injection of neoarsphenamine

a scarlatiniform rash appeared over the chest and abdomen; conjunctivae were injected; tonsils were buried and injected; and temperature was 102.2° F. He complained of severe headache and some nausea. The rash gradually became erythematous involving the face, body, and upper extremities. He was given 1 gram of sodium thiosulphate intravenously on September 1 and 3. Recovery in 11 days.

(*12—1937.*) This patient was exposed to infection on September 13, 1937, and 3 days later a small sore developed on the glans penis which healed without treatment. On October 3 the patient complained of a body rash, headache, and general malaise. Examination showed a characteristic maculopapular eruption on the abdomen and chest; temperature 104.4° F., and a 4-plus Kahn blood test.

The secondary rash disappeared and he was given a 0.3 gram injection of neoarsphenamine on October 4, and 0.4 gram injections on October 7, 10, and 14. Five hours after the last injection, the skin and conjunctivae were flushed, temperature was 104.4° F. and pulse, 136. He was given 1 gram of sodium thiosulphate intravenously. The following morning a marked erythematous rash appeared on the body and extremities and his temperature ranged from 100° to 103° F. Two days later the rash began to fade leaving the skin very dry, followed by a fine brany scaling. His temperature gradually dropped to 99° F. Eight days after the last injection of neoarsphenamine the patient was nauseated and the sclera and skin showed a slight icteric tinge. Recovery in 14 days.

(*13–1937.*) One month after exposure on August 1, 1937, this patient developed a lesion on the shaft of the penis and general adenopathy. A darkfield examination of the lesion was positive for *Treponema pallidum* and a Kahn blood test was 4-plus.

He was given a 0.3 gram injection of neoarsphenamine on September 26, 1937, followed by a 0.45 gram injection on October 1, and a 0.3 gram injection on October 9. Four injections of bismuth salicylate were given as concurrent treatment. Three days after the 0.45 gram injection of neoarsphenamine on September 26 the patient developed a mild skin rash which was thought to be a syphilitic rash. He had no complaint or symptoms other than the rash and a slightly elevated temperature. About 12 hours following the injection of neoarsphenamine on October 9 the patient complained of feeling warm and itching skin. Examination showed a diffuse erythema of the skin, which cleared in 2 days and left a fine brany scaling. Recovery in 9 days.

On October 20, 1937, he was given a 0.1 gram injection of neoarsphenamine which caused a recurrence of the mild erythematous rash. Neoarsphenamine was discontinued and mapharsen and bismuth therapy instituted.

(*14–1937.*) After exposure to infection this patient developed a penile lesion and general adenopathy. A darkfield examination of the lesion was positive for *Treponema pallidum.*

He was given a 0.3 gram injection of neoarsphenamine on October 4, 1937, and 0.45 gram injections, October 8 and 12. Three and one-half hours after the last injection the patient complained of headache, nausea, and weakness; within 6 hours there were chills and a temperature of 105° F. Examination showed a faint generalized macular rash. He was given 1 gram of sodium thiosulphate intravenously. His temperature returned to normal within 24 hours. Recovery in 72 hours.

(*15–1937.*) Three weeks after this patient was infected a lesion developed on the penis. Repeated darkfield examinations of the lesion were negative for *Treponema pallidum* and a Kahn blood test was 4-plus.

From December 18, 1928, to July 30, 1929, he received 11 injections of neoarsphenamine (total amount not recorded). Between the dates of April 2, 1930, and May 20, 1931, he received 5.05 grams of mercury as daily inunctions. From

March 23 to May 19, 1937, he received nine injections of bismuth salicylate and from May 26 to July 21, nine injections of neoarsphenamine, a total of 5.1 grams.

The fourth course of arsenical treatment began with a 0.3 gram injection of neoarsphenamine on September 29, 1937, followed by a 0.6 gram injection on October 6. Six days after the last injection the patient developed a slight rash on the abdomen. He did not report this condition until the morning of October 13 when he appeared for the third injection of neoarsphenamine. Upon examination a faintly pink, widely scattered, macular type rash was noted. It was not a typical drug rash. Mapharsen was substituted for neoarsphenamine and he was given a 0.04 gram injection on October 13 and a 0.06 gram injection on October 20, at which time the rash was disappearing. On October 26, 20 days after the last injection of neoarsphenamine and 6 days after the last injection of mapharsen, the skin of the arms and forearms was very red. The following morning a maculopapular rash appeared on the trunk and extremities and developed into an erythematous skin condition which responded to treatment. He received 4 injections of sodium thiosulphate intravenously. Recovery in 52 days after the onset of first symptoms.

(*16–1937.*) This patient was exposed to infection on July 24, 1936, and developed a lesion on the penis which was positive for *Treponema pallidum*. Repeated Kahn blood tests were negative.

He received the following treatment: From August 8 to 29, 1936, 3 injections of neoarsphenamine, a total of 1.05 grams; from September 5 to October 2, 1936, 5 injections of bismuth salicylate; from October 13 to December 4, 1936, 8 injections of neoarsphenamine, a total of 4.35 grams; and from November 27, 1936, to February 12, 1937, 10 injections of bismuth salicylate.

On February 12, 1937, the patient complained of a rash on the right arm and leg involving tattooed areas. Examination showed a pruritic eruption on the arm and leg, and a discrete, erythematous, macular rash over the trunk, considered to be a syphilid condition and evidence of relapse. A course of neoarsphenamine was instituted with a 0.3 gram injection on February 12, a 0.45 gram injection on February 19, and 0.6 gram injections on February 27, March 5, and 13. The patient received the first three injections without any noticeable effect on the rash. After the last two injections the macules seemed to flare and become scarlet, followed later by central desquamation. The patient had no complaint and the rash showed signs of fading.

On March 25 he was given a 0.4 gram injection of arsphenamine, which caused the rash to brighten up for about 1 day, and following a 0.4 gram injection on April 1 there was a recurrence of the rash coupled with some constitutional symptoms. The rash faded but it was not considered advisable to continue the use of arsenicals and a course of bismuth salicylate was started. Flushing of the skin followed the first injection on April 6 and no symptoms followed the second injection given on April 13. The third injection given on April 20 caused an increase in the rash. Treatment was discontinued but the rash persisted. The skin condition gradually spread to the face and cleared after 3 weeks symptomatic treatment.

He was given a 0.03 gram injection of mapharsen on July 1 and a 0.04 gram injection on July 8, without signs or symptoms of further reaction. Recovery in 124 days after onset of the first symptoms.

(*17–1937.*) After exposure to infection on October 17, 1936, this patient developed an indurated ulcer on the prepuce which was positive for *Treponema pallidum*.

From December 1, 1936, to August 5, 1937, he received 24 injections of neoarsphenamine, a total of 17.05 grams, and as concurrent treatment 24 intramuscular injections of bismosol. The third course of arsenical treatment began with a 0.3 gram injection of neoarsphenamine on October 8, 1937, followed by a 0.45 gram

injection on October 14, and 0.6 gram injections on October 22, 28, November 5, 12, 18, and 26. Three injections of bismosol were given as concurrent treatment.

Twenty days after the last injection of neoarsphenamine examination showed a mild eczematous rash on both legs and slight edema of the ankles and feet. The dermatitis was believed to be due to the entire treatment and not the result of any particular dose. The face and upper extremities became involved and the skin condition gradually developed into a mild exfoliative dermatitis which showed steady improvement under treatment. Recovery in 20 days.

SEVERE REACTIONS

The nine severe reactions occurred after the following number of injections: One after the first, fifth, sixth, and seventh; two after the eighth; one after the ninth and thirty-eighth; and one after the seventh injection of the third course of arsenical treatment (total number of injections not known). The interval between the injection and appearance of symptoms varied from 6 hours to 10 days. The length of time required for recovery varied from 24 days to 118 days.

NEOARSPHENAMINE

(18–1937.) This patient was given a diagnosis of syphilis on April 2, 1937, because of repeated positive Kahn blood tests and a history of a penile lesion in July 1931.

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on March 10, 1937, followed by a 0.45 gram injection on March 17, and 0.6 gram injections on March 31, April 7, 14, 21, and 28. Eight intramuscular injections of bismosol were given as concurrent treatment. Approximately 24 hours after the last injection of neoarsphenamine the patient complained of burning and itching skin over the arms and legs. Examination on May 6, 8 days after the last injection of neoarsphenamine, showed definite evidence of inflammation with duration and serous exudate from the extensor surfaces of the skin on the forearms and legs. RBC 5,250,000; WBC 12,400; hgb 90 percent; bands, 8; segments, 84; lymphs, 21; eosins, 5; monos, 2. The skin condition rapidly spread to the arms, hands, and feet.

The patient was given 1 gram of sodium thiosulphate intravenously on May 6, 7, 8, 9, 10, 12, and 31. The skin condition gradually developed into a severe exfoliative dermatitis involving the scalp, without loss of hair or damage to finger and toe nails. Recovery in 39 days.

(19–1937.) Following exposure to infection on March 25, 1937, this patient developed a penile lesion which was positive for *Treponema pallidum.*

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on April 8, 1937, followed by eight weekly injections of 0.6 gram each. Four injections of bismuth salicylate were given as concurrent treatment. Six hours after the last injection of neoarsphenamine, given on June 3, 1937, the patient complained of generalized itching and reddening of the skin. Physical examination otherwise normal. After questioning, the patient stated that 2 days following the eighth injection of neoarsphenamine, given on May 27, he noticed a slight itching over the shoulders which disappeared within 3 days. The skin condition gradually became worse and on June 11 examination showed an exanthematous skin eruption over the entire body more pronounced on the chest and shoulders with some oozing of serum from the areas most involved. The skin has a thickened, rough,

and red appearance with a prominence of the individual hair follicles. He was given 1 gram of sodium thiosulphate intravenously on June 8 and 11. The skin condition developed into a severe exfoliative dermatitis with areas most involved showing serous weeping.

Blood picture

Date	Red blood count	White blood count	Hemoglobin	Band forms	Lymphocytes	Segmented	Eosinophiles	Basophiles	Monocytes	Juveniles
June 7, 1937	4,110,000	12,850	....	3	17	75	2	2	3	....
June 11, 1937	4,900,000	22,800	80	30	13	42	4	....	6	5
June 29, 1937	3,950,000	7,400	80	13	8	57	20	....	....	2
July 8, 1937	3,775,000	9,200	....	10	21	55	31	....	3	....
July 12, 1937	3,600,000	7,800	80	2	20	53	25	....	....	....
July 26, 1937	4,175,000	3,300	90	3	19	65	11	....	2	....

The skin condition showed steady improvement after 2 weeks treatment. Recovery in 118 days.

(*20–1937.*) One month following exposure to infection this patient developed a penile lesion which was positive for *Treponema pallidum*. He was given a 0.3 gram injection of neoarsphenamine on May 29, 1937, followed by seven weekly injections of 0.7 gram each. Twenty-four hours after the seventh injection given on July 6, 1937, the patient complained of a maculopapular rash over the trunk and extensor surfaces of the extremities. Patch tests on July 7 and 8 were negative. The patient admitted exposure to the sun and the use of an irritant soap. The rash did not appear typical of arsenical poisoning and neoarsphenamine was continued. Following the eighth injection of neoarsphenamine, given on July 13, the rash became worse with slight itching. Macules confluent. The rash gradually developed into a generalized exfoliative dermatitis. He was given 1 gram of sodium thiosulphate intravenously daily for 15 days.

Blood picture

Date	Erythrocytes	Leukocytes	Hemoglobin	Neutrophiles		Eosinophiles	Lymphocytes	Monocytes	Platelets
				Mature	Immature				
July 13, 1937	9,500,000	9,200	90	55	17	7	19	2	....
July 16, 1937	....	....	....	27	14	45	12	2	318,750
July 23, 1937	....	11,800	....	60	6	....	26	8	....
Aug. 4, 1937	4,850,000	8,800	90	37	4	40	18	1	....
Aug. 16, 1937	4,460,000	9,500	88	63	3	....	30	4	....
Aug. 26, 1937	4,990,000	7,700	98	37	1	10	48	4	....
Sept. 8, 1937	4,660,000	8,200	90	75	4	5	12	4	....
Sept. 14, 1937	5,500,000	8,900	102	54	5	10	30	1	....

The skin condition gradually improved after treatment. Recovery in 63 days.

(*21–1937.*) After exposure to infection on July 6, 1937, this patient developed a sore on the penis which was positive for *Treponema pallidum*.

From August 28 to September 18, 1937, he received four injections of neoarsphenamine, a total of 1.9 grams. Arsenical treatment was continued and he was given a 0.6 gram injection of neoarsphenamine on September 24 and October 1, 1937. Ten days after the last injection of neoarsphenamine a mild pruritic, erythematous rash appeared over the chest and arms. No one dose can be selected as the causative agent and it is believed that the condition is due to the cumulative effect of the arsenic in all doses. The patient had no complaint other than the rash. Arsenical treatment was discontinued. He was given 0.13 gram intramus-

cular injections of bismuth salicylate on October 11, 15, and 22. On October 8, 1937, examination of the patient showed extension of the eruption to the lower arms and legs, with weeping and excessive desquamation above the left elbow. He was given 1 gram of sodium thiosulphate intravenously on October 28, 29, 30, November 1 and 5. The course of the disease was uneventful until November 9, after which there was marked swelling of the legs and ankles. An exfoliative dermatitis developed which showed steady improvement under treatment. Recovery in 35 days.

(*22–1937.*) This patient was infected on November 22, 1933, and developed an indurated ulcer on the dorsal prepuce which was positive for *Treponema pallidium*. A macular rash appeared over the face and body. Repeated Kahn blood tests were 4-plus.

From January 18, 1934, to June 6, 1936, he received 25 injections of neoarsphenamine, a total of 11.7 grams, and 13 injections of a bismuth compound and 10 injections of mercury succinimide as concurrent treatment.

The fifth course of arsenical treatment began with a 0.45 gram injection of neoarsphenamine on December 15, 1936, followed by 12 weekly injections of 0.6 gram each. Ten injections of bismuth salicylate were given as concurrent treatment. Since January 1, 1937, the patient has been treated intermittently for apparently benign fungoid lesions on the dorsum of the hands and ventral surface of the forearms. Before each injection of neoarsphenamine in the last course of treatment the patient was questioned carefully and no apparent aggravation of these lesions was noticeable. Eight hours after the last injection, given on March 16, examination of the patient showed a maculopapular rash over the body and extremities, with confluent lesions over the flexor surfaces of the elbows. The condition gradually developed into exfoliative dermatitis and showed steady improvement from beginning of treatment. Recovery in 69 days.

(*23–1937.*) After exposure to infection on October 6, 1937, this patient developed a penile lesion which was repeatedly negative for *Treponema pallidum*. A Kahn blood test was 4-plus on October 26.

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on November 3, followed by six weekly injections of 0.6 gram each. Four days after the last injection, given on December 15, the patient noticed a prickly heat type of rash over the neck and forearms, which was not reported until December 21, 6 days after the injection was given. Examination at this time showed an erythematous rash of the face, neck, and forearms which gradually spread to the trunk. He was given 1 gram of sodium thiosulphate intravenously on December 21, 22, and 23, following which the rash showed signs of fading. There were no other symptoms. On December 26 examination showed a more severe rash, edema of the face, neck, and ankles, injected conjunctiva, and a thick, leathery skin presenting a typical picture of a generalized exfoliative dermatitis. The skin condition was normal after 66 days of treatment. Loss of considerable hair over frontal area of the head was noted.

(*24–1937.*) The source of infection in this case is unknown. The patient (supernumerary, Veteran, U. S. Army) was given a diagnosis of syphilis because of repeated 4-plus Kahn blood tests. Treatment began with 0.13 gram intramuscular injections of bismuth salicylate on June 19 and 22, and a 0.3 gram injection of neoarsphenamine on June 23, 1937. About 12 hours after the injection of neoarsphenamine he complained of headache and developed an itching scarlatiniform rash over the entire body. The patient stated he had a similar reaction about 10 years ago following an injection in the arm for treatment of an ulcer on the medial aspect of the thigh. The scar has the appearance of a healed tertiary ulcer. The skin condition developed into a severe exfoliative dermatitis which improved rapidly under treatment. He was given 1 gram of sodium

thiosulphate in the morning and 1 gram in the afternoon on June 23, 24, 25, 26 and 1 gram daily for the following 9 days. Recovery in 26 days.

(*25–1937.*) The source of infection in this case is unknown. The patient (supernumerary female) was given a diagnosis of syphilis because of a secondary skin rash and positive blood tests.

From December 18, 1935, to August 18, 1936, she received a total of 4.1 grams of neoarsphenamine and a total of 3.12 grams of bismuth salicylate.

The third course of arsenical treatment began with a 0.3 gram injection of neoarsphenamine on January 12, 1937, followed by a 0.3 gram injection, January 26; a 0.45 gram injection, February 2; 0.3 gram injections, February 16, March 2, and 16; and a 0.45 a gram injection, March 23. As concurrent treatment 11 injections of bismuth salicylate were given.

Two days following the last injection of neoarsphenamine the patient developed a lesion about 1½ inches in diameter on the right tibia. The lesion gradually increased in size and started to weep. The face and upper and lower extremities were next involved with the lichenoid type of lesion. One gram of sodium thiosulphate was given intravenously on April 9, 10, and 11, and 1 gram of calcium gluconate 12 to 18 hours apart until 12 grams were given. The skin condition gradually developed into a severe exfoliative dermatitis and showed steady improvement under treatment. Recovery in 72 days.

MAPHARSEN

(*26–1937.*) Three weeks after exposure to infection on December 28, 1926, this patient developed a penile lesion which healed within 10 days. Two months later a secondary skin rash appeared over the trunk and extremities. A Kahn blood test was 1-plus. He was given 0.45 gram injections of neoarsphenamine on March 19, 26, and April 2, 1927, and 3 injections of mercury salicylate, 1 grain each, as concurrent treatment. Twenty-four hours after the last injection of neoarsphenamine he developed a severe exfoliative arsenical dermatitis. Recovery in 81 days.

On December 19 and 22, 1927, he was given 0.13 gram injections of bismuth salicylate. A mild exfoliative dermatitis followed the two injections of bismuth salicylate and all antiluetic treatment was discontinued. Between July 27 and August 5, 1935, he received five mercury inunctions resulting in a dermatitis which lasted 3 weeks.

The patient had received no arsenical treatment or treatment with metal compounds since August 1935. Kahn blood tests were 4-plus on May 13 and June 1, 1937. A 0.03 gram injection of mapharsen was given on June 9. Eight hours after the injection he noted a marked itching and burning of the skin over the lower abdomen, flanks, buttocks, and upper thighs. Two hours later the arms and forearms were involved, most marked in the region of antecubital fossae. The following morning a diffuse macular rash appeared over these areas, followed by generalized itching. The skin condition followed the course of a typical exfoliative dermatitis, from June 21 to July 2. He was returned to duty July 3 with no evident kidney, liver, or skin damage. Recovery in 24 days after onset of the first symptoms.

SUMMARY

In 1937 medical officers of the Navy administered 107,533 doses of arsenicals and reported the occurrence of 49 reactions therefrom. Of these reactions more than one-half (26) were arsenical dermatitis; a ratio of one case of dermatitis to 4,135 doses. Of interest in connection with the etiology of arsenical dermatitis is the number of instances in

which premonitory signs were noted. These signs are repeated below and serve to indicate the necessity for careful examination and questioning of each patient before administering an arsenical.

Case 3.—Unreported nausea and lassitude was followed by a macular rash 2 days later.

Cases 7 and 8.—A mild erythematous rash followed the twentieth injection of neoarsphenamine. The next injection given 14 days later caused recurrence of the rash.

Case 9.—An erythematous rash followed the second injection of neoarsphenamine. The third injection given 7 days later caused nausea and vomiting, rise in temperature, and flushed skin.

Case 10.—A vasomotor phenomena reaction followed the second injection of neoarsphenamine. An erythematous rash followed the third injection given 4 days later.

Case 13.—A mild skin rash followed the second injection of neoarsphenamine. An erythematous rash followed the third injection, and the fourth injection caused recurrence of the rash.

Case 15.—Six days after the last injection of neoarsphenamine a faint macular rash developed. Under observation and after receiving 2 injections of mapharsen the rash developed into a mild erythematous dermatitis.

Case 16.—A pruritic eruption developed 2 months after the last injection of neoarsphenamine. A mild arsenical dermatitis (fixed exanthem) followed the next five injections of neoarsphenamine.

Case 19.—Unreported body rash followed the eighth injection of neoarsphenamine. A severe exfoliative dermatitis followed the ninth injection given 8 days later.

Case 20.—A maculopapular rash followed the seventh injection of neoarsphenamine. A severe exfoliative dermatitis followed the eighth injection given 1 week later.

Case 23.—Unreported prickly heat type of rash followed the seventh injection of neoarsphenamine. Six days later a severe exfoliative dermatitis developed.

Case 26.—A severe arsenical dermatitis followed the third injection of neoarsphenamine. Nine months later dermatitis followed treatment with bismuth and mercury compounds. Ten years later a severe exfoliative dermatitis followed the first injection of mapharsen.

TRAFFIC INJURIES

A STUDY BY POST MEDICAL DEPARTMENT[1]

By Captain W. L. MANN, Medical Corps, United States Navy

The appalling loss of manpower to the naval service due to traffic accidents has been receiving more and more attention from the

[1] Credit is hereby acknowledged to Lt. W. V. Clark, Medical Corps, United States Navy, for the compilation and tabulation of data.

proper authorities. Urgent and effective measures have been taken in an endeavor to diminish local traffic accidents.

A broad conception of the mission of a medicomilitary department is to prevent any avoidable loss in personnel or diminution in its effectiveness. Since our naval medical records demonstrate conclusively that traffic injuries constitute the large majority of all accidental injuries, the primary purpose of presenting this analytical study is in hopes that it will serve in a minor manner to demonstrate in which direction efforts should be concentrated in attempting to minimize the loss of military power from accidental injuries, particularly traffic injuries.

During the calendar year 1937 this medical department has treated 127 patients suffering from major and minor injuries due to motor vehicles. Our list of patients treated for traffic injuries does not give a complete picture of the number of accidents, for the following reasons:

1. Some of the minor cases of injuries, for various reasons, failed to report for treatment or sought treatment elsewhere.
2. This list of patients does not include all accidents, as in some accidents there was often—miraculously—no injury to personnel. For example, in 1935, one member of this post was said to have been driving a new automobile at a high rate of speed (70 m. p. h.), when the car overturned, rolled over 5 or 6 times, then skidded upside down for 300 feet along the concrete highway. When the upside-down car, completely wrecked, came to rest, the driver stepped out, unhurt, and hitchhiked back to Quantico.

The writer started studies of traffic accidents in 1932, and since that time the marked increased speed of modern automobiles has assumed place as a dominating factor in the cause of traffic injuries as shown below:

1. At 25 miles an hour a moving car has developed about enough energy to roll over once. Your body could probably "take" this.
2. At 50 it has developed not twice, but 4 times the energy—enough to roll over 4 times. You'd have to be lucky to come out of this one alive.
3. And at 75 it has developed not 3 times, but 9 times the energy—enough to roll over 9 times. Of course, it probably would hit a tree or a culvert long before it did its ninth somersault and then the unused portion of energy would be spent in ripping the culvert, the car, and its occupants to pieces.[2]

The various tables of local accidents in this study are based upon the number of patients treated, not upon the number of accidents. For instance, if five patients are injured when an automobile collides with a parked truck, our records will show five patients and not a single accident. The reason for this sort of tabulation is that a medicomilitary department is interested primarily in "avoidable personnel loss" in relation to a specific type of accident and not in the type of accident per se.

[2] Death Begins at Forty, published by the Travelers Insurance Co , Hartford, Conn., has been freely utilized in preparation of this study, particularly in regard to national traffic accidents.

ECONOMIC CONSIDERATION

1. Roughly estimating (*a*) the cost of burial expenses, (*b*) cost of medical treatment, (*c*) expense of the death gratuity, (*d*) the loss of the services of a trained and experienced soldier, and (*e*) that a certain percentage of deceased individuals carry Federal life insurance, it appears not unreasonable to assume that each fatal injury represents about $12,000 loss to the Government. It is estimated that each case invalided from the service represents a $10,000 loss.

2. Placing the value of a disabled man's services at $2 a day, with an additional expense of $3 a day for hospitalization charges, there was an approximate loss to the Government of $63,545 for traffic accidents in the personnel of this organization for the calendar year 1937 (fatal and nonfatal cases), as shown by the following figures:

1935	1936	1937		1935	1936	1937
3	1	5	Deaths at $12,000	$36,000	$12,000	$60,000
3	0	0	Invalided from service at $10,000	30,000	0	0
2,500	1,045	709	Hospital sick days at $5	12,500	5,225	3,545
			Total	78,500	17,225	63,545

The incidence of service traffic accidents showed a progressive increase until 1931, from which year until 1936 there was a gradual decrease, as demonstrated by the following data from reports of the Surgeon General, United States Navy.

Year:	*Admission rate per 100,000*	Year:	*Admission rate per 100,000*
1927	659	1932	1,080
1928	694	1933	1,017
1929	861	1934	766
1930	1,006	1935	774
1931	1,113	1936	691

The accident statistics for United States Highway No. 1 from Fredericksburg to Alexandria, Va., for period January 1, 1936, to June 30, 1937, is as follows:

Number of accidents	465
Fatal accidents	30
Injury accidents	196
Property-damage accidents	239
Fatalities	41
Injuries	422
Property damage	$146,242
Vehicles involved	829

This portion is a three-way highway which is exceedingly dangerous, as it passes through undulating country, which causes the north-bound traffic to "fight" with south-bound traffic on the hills for the center roadway.

The status of patients treated for traffic injuries are classifiable as follows:

	Nonincapacitated			Incapacitated			Total		
	1935	1936	1937	1935	1936	1937	1935	1936	1937
Military patients	39	18	14	73	39	36	112	57	50
Nonmilitary (dependents and civilians)							81	95	77
Total							193	152	127

The types of vehicles involved are listed below:

	Number of accidents			Number of patients		
	1935	1936	1937	1935	1936	1937
Automobile—passenger	72	53	48	98	121	108
Trucks	3	11	5	8	20	7
Motorcycles	4	5	3	4	8	5
Bicycles	2	0	2	2	0	2
Tractors	0	2	1	0	3	2
Tank	0	0	1	0	0	2
Trailer	0	0	1	0	0	1
Total	81	71	61	112	152	127

INTOXICATED WHEN TREATED

	1936	1937
Service personnel	5	4
Civilians	11	10

Hence, alcohol is considered an unimportant contributory factor.

Average age of drivers involved in traffic accidents:

	Average in years
Service personnel	26.82
Civilians	30.00
Total average	28.41

TABLE 1

	Total injured			Number owning motor vehicles			Ratio of injuries to owners of motor vehicles		
	1935	1936	1937	1935	1936	1937	1935	1936	1937
Commissioned, chief warrant, and warrant officers	8	2	2	330	330	567	1–41.25	1–165	1–283.5
First pay grade	0	3	1	64	64	75	0–64	1–21.33	1–75
Second pay grade	4	3	0	79	79	44	1–19.75	1–26.33	0–44
Third pay grade	2	1	0	26	26	60	1–13	1–26	0–60
Fourth pay grade	7	3	8	69	69	100	1–9.85	1–23	1–12.5
Nonrated men, 5th, 6th, and 7th pay grades	91	45	39	139	139	205	1–1.52	1–3.09	1–5.26

Discussion of table 1.—Note the ratio of injuries to the number owning automobiles is in inverse ratio to the ratings; the same applies to rank, but the small number of injuries in officer personnel does not warrant the detailed classification.

TABLE 2.—*Types of fractures, military and nonmilitary patients*

	1935	1936	1937		1935	1936	1937
Broken neck	2	1	0	Fracture of bones of face	4	6	5
Broken back	1	0	0	Miscellaneous (scapula, clavicle, etc.)	5	4	3
Fractured skull	5	4	4	Injuries, multiple extreme	4	2	9
Fractured pelvis	1	2	2	Fracture, ribs	0	2	5
Fractured leg	12	8	8	Fracture of foot	0	1	1
Fracture of arm and forearm	4	5	3				
Fracture of hand	4	2	5				

One fracture of arm required amputation, and two fractures of the leg resulted in amputation in 1935–36.

Note in past 3 years 13 cases of fractured skull.

TABLE 3.—*Types of accidents*

	1935	1936	1937		1935	1936	1937
Collision with:				Fixed objects:			
Pedestrian	9	11	10	Lamp post	3	0	0
Bicycle	2	0	0	Tree	4	6	3
Motorcycle	5	5	3	Ditch	13	8	3
Trailer	2	0	0	Embankment	13	4	7
Train	1	0	1	Underpass	3	0	4
Tractor	0	2	1	Bridge	1	2	1
Automobile or truck:				Cement water trap	4	0	0
Side swipe	14	12	4	Fence	2	0	1
Head-on collision	37	23	15	Telephone pole	0	3	4
Head-to-rear	14	7	3	Overturned	30	18	24
Parked automobile or truck	13	5	2	Fall from	4	3	3
				Miscellaneous	21	4	3

This table is based upon the number of patients treated for injuries caused by type of accidents listed:

	Cases of injuries		
	1935	1936	1937
Overturning caused	30	18	24
Collisions caused	140	88	62

TABLE 4

	Total admitted	Rate per 1,000	Invalided from service	Sick days
U. S. Navy, calendar year—				
1934	838	7.66	37	32,350
1935	884	7.74	32	33,597
1937	860	6.91	26	33,833

	1935	1936	1937	1935	1936	1937	1935	1936	1937	1935	1936	1937
Marine Barracks, Quantico, Va., service personnel only (assuming 3,000 average daily strength)	73	39	36	24.33	13.0	12	3	0	0	2,508	1,045	709

In the above table, due allowance must be made for the fact that the larger proportion of the naval service is afloat, which restricts the days available for automobile driving, whereas the rate admitted from this post is based on 365 available driving days per individual.

FUNDAMENTAL CAUSATIVE FACTORS OF RECKLESS DRIVING

While it is highly probable that percentages of traffic accidents are only slightly higher among the enlisted class than among similar age groups in civil life (i. e., high school and college students), yet the sudden release of the restraint of military routine on men going on liberty apparently produces a psychological explosion in some of the younger men.

Unnecessarily fast and reckless driving by a sailor may then be considered a modern counterpart of the traditional manifestations of his prototype of days gone by.

The irresponsibility and exuberance of youth as another fundamental factor is demonstrated by the fact that slightly over 88.9 percent of those injured were of second pay grade or below.

As to be expected, admonitions and disciplinary measures are more effective with older men; youth is apt to be indifferent and unresponsive. Consequently, the results of disciplinary measures in the reduction of traffic injuries are more noticeable in the older age groups.

The statistics of the Minister of Transportation in England reports 60 percent of all fatal accidents are caused by young drivers still in their "teens." Estimating this age group as composing 10 percent of drivers in England, the danger factor of this age group would be 1,400 percent higher than for the average percentage of all other age groups.

NATIONAL TRAFFIC ACCIDENTS

Since traffic accidents constitute a national and a local problem, it may be interesting to include some of these figures in this report for the purpose of comparison.

The number of persons killed and injured in the United States during 1931 totaled 1,032,000, or as many people as the population of Nevada, Delaware, Wyoming, and the District of Columbia combined.

The casualties resulting from automobile accidents for an 18-month period ended December 31, 1931, is compared below for a like period to the battle casualties of the American Expeditionary Force.

	Killed	Injured
World War	50,510	122,674
Automobiles	53,650	1,576,840

The national economic loss due to automobile accidents is $2,500,-000,000 or more than the annual cost of public school education in the United States.

The automobile accident deaths by 5-year periods are as follows:

1916–21	58, 522
1921–26	98, 551
1926–31	152, 732
1931–36	172, 715

National statistics show that youth of the driver is a contributory factor in causing automobile accidents—drivers 20 to 29 years of age have 100 percent more accidents than drivers in the fifth decade.

Similar figures are shown in the Surgeon General's report for United States Navy for 1936.

The injury rate per 1,000 for officers 35 to 39 years old is 2.94.

The injury rate per 1,000 for officers 20 to 24 years old is 10.24—over 300 percent greater than above.

The attached chart (fig. 16) illustrates the high ratio of traffic accidents in the low rate groups as compared with more mature men.

Discussion of Chart

1. Correlation in the findings for 5 different years and for two military organizations—one on west coast and one on east coast—that the danger factor varies inversely with the ratings.
2. The chart presents indisputable evidence that automobile driving at least for senior ratings in these localities is a fairly safe procedure.
3. Consequently the corollary can be drawn, viz, the vast majority of service motor accidents are avoidable.

Table 5.—*Principal driving errors, entire Nation, 1937, and number of injuries and deaths resulting*

	Persons killed	Percent	Persons injured	Percent
Exceeding speed limit	9, 380	36. 8	227, 560	24. 9
On wrong side of road	3, 440	13. 5	124, 290	13. 6
Did not have right-of-way	3, 030	11. 9	197, 400	21. 6
Cutting in	510	2. 0	37, 470	4. 1
Passing standing streetcar	100	0. 4	3, 660	0. 4
Passing on curve or hill	360	1. 4	11, 880	1. 3
Passing on wrong side	230	0. 9	9, 140	1. 0
Failed to signal and improper signaling	310	1. 2	53, 920	5. 9
Car ran away—no driver	50	0. 2	2, 740	0. 3
Drove off roadway	1, 890	7. 4	53, 010	5. 8
Reckless driving	4, 440	17. 4	138, 910	15. 2
Miscellaneous	1, 760	6. 9	53, 920	5. 9
Total	25, 500	100. 0	913, 900	100. 0

It will be noted in the table above that excess speed was the primary driving error.

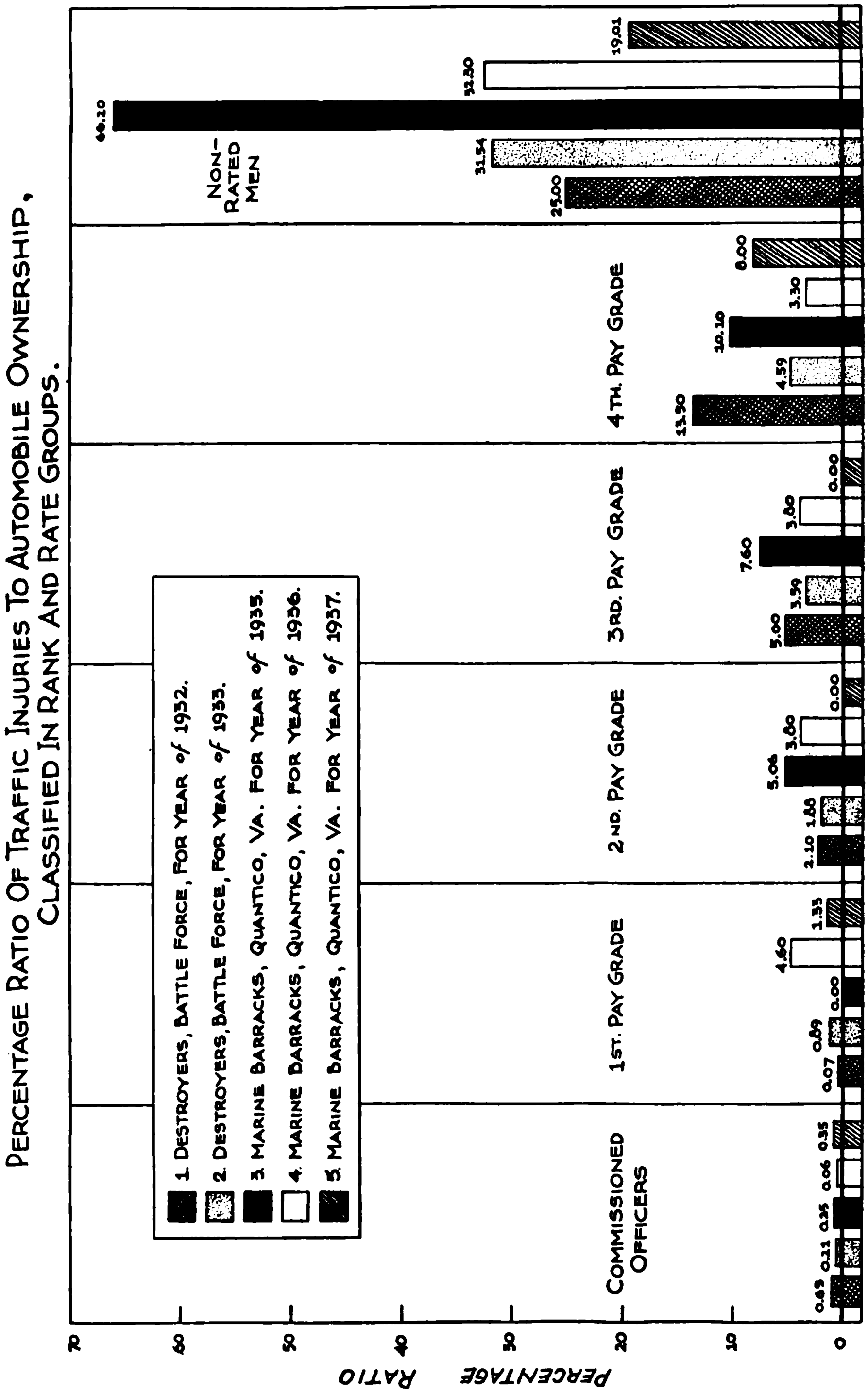

Figure 16.

86860—38——12

TABLE 6.—*Types of collision accidents, entire Nation, 1937, resulting in injuries and deaths*

	Persons killed	Percent	Persons injured	Percent
Collision with—				
Pedestrian	17, 410	43. 2	310, 160	25. 4
Automobile	10, 600	26. 3	677, 510	55. 5
Horse-drawn vehicle	120	. 3	5, 600	. 5
Railroad train	1, 730	4. 3	7, 470	. 6
Streetcar	320	. 8	14, 540	1. 2
Other vehicle	120	. 3	4, 040	. 3
Fixed object	4, 560	11. 3	88, 060	7. 2
Bicycle	810	2. 0	31, 890	2. 6
Noncollision	4, 310	10. 7	77, 170	6. 3
Miscellaneous	320	. 8	4, 650	. 4
Total	40, 300	100. 0	1, 221, 090	100. 0

WORSE THAN WAR

Our Nation has engaged in 6 major wars since its birth in 1776. In total, these wars extended over a period of 15 years. The number of American soldiers killed in action or died of wounds during these 15 years of war was 244,357.

Now look at our 15-year peacetime record of death on the highways:

1923	18, 031	1928	27, 618	1933	31, 078
1924	19, 228	1929	30, 858	1934	35, 769
1925	21, 628	1930	32, 540	1935	36, 023
1926	23, 264	1931	33, 346	1936	37, 500
1927	25, 533	1932	29, 196	1937	40, 300

Fifteen years of war, 244,357 casualties; 15 years of peace, 441,912 traffic deaths!

In war, our soldiers fought and died for a purpose. But what purpose can there be in the killing of these hundreds of thousands on the highways?

Truly, this traffic slaughter is worse than war.

SUMMARY

The foregoing discussion of traffic injuries of the personnel of Marine Barracks, Quantico, Va., is hereby summarized.

1. The number of cases dealt with in this study is sufficiently large, so it is believed, to warrant the general deductions herein expressed.

2. Traffic accidents resulted in:

	1935	1936	1937
(a) Admissions to sick list	73	39	36
(b) Men killed	3	1	5
(c) Invalided from service	3	0	0
(d) Men hospitalized	73	39	36

3. Such accidents represented in loss to the Government approximately $78,500 in 1935; $17,225 in 1936; $63,545 in 1937.

4. The older officers and higher ratings were strikingly less predisposed to traffic accidents.

5. The vast majority of accidents may be classed as avoidable as indicated by the fact that the higher-rated men were able to drive automobiles with very few accidents during 1937.

6. Youth was a most important contributory factor.

7. Gratifying results are already in evidence, attributed to the Commanding General's campaign against reckless driving.

The following tabulation (tables 7 and 8) presents the injuries and disabilities among service personnel treated by the Medical Department, Marine Barracks, Quantico, Va., during the calendar year 1937. The tables in this report were prepared from an analytical study of these data.

TABLE 7.—*Not incapacitated*

Rate and age	Extent of injury	Passenger or driver and cause, etc.
Pvt., 23	Contusion, right knee	Passenger. While going downhill, driver of tractor struck a rock, overturning, and patient jumped off, causing the injury.
Pvt., 23	Laceration, lip, and broken teeth	Passenger. Car had to stop quickly and threw patient into windshield.
Pvt., 21	Laceration left, upper eyelid; laceration, chin and right knee.	Driver. Forced off road by truck into ditch.
Pvt., 28	Wound, lacerated left cheek, 2-inch	Passenger on running board. Was standing on running board of car while backing into filling station and was caught between car and door.
Pvt., 20	Laceration of thumb, ring finger, middle finger of right hand.	Driver. Cranking truck and it kicked, throwing patient against truck.
Pvt., 23	Abrasions, forehead and left hand	Passenger. While returning to Quantico from Triangle, driver went to sleep, car hit post, and overturned.
1st. Lt., 27	Laceration (small), each side of forehead.	Driver of tank. While driving tank ran into tree.
ChMarGn., 47	Fracture, scaphoid right wrist	Driver. Was driving along highway, another car struck him head-on, due to going to sleep.
Sea. 1c., 29	Laceration, ¾-inch, chin; laceration, 1¼-inches, left wrist; 1-inch laceration, right elbow.	Driver. Car in front suddenly stopped, causing patient's car to swerve and hit bridge abutment.
PhM 3c., 21	Laceration, 1-inch, upper lip	Passenger. Ran into back of parked truck to avoid hitting oncoming car.
PhM 3c., 22	Contusion, right leg, foreign body in eye.	Driver. Head-on collision—curve at Dumfries.
Pfc., 29	Laceration, right upper eyelid; contusion, face.	Driver. Struck curbing on roadside due to being blinded by oncoming car.
Sgt., 30	Multiple lacerations, face	Passenger. Car in which patient was riding collided with another car head-on—due to other car being on wrong side of road and without lights.
Cpl., 31	Laceration, ½-inch, upper lip; contusion ,right knee.	Driver. Head-on collision with another car on a curve.

TABLE 8.—*Incapacitated*

Rate and age	Extent of injury	Final disposition and total sick days	Contributory or causative agent
Pvt., 24	Wound, lacerated scalp and right frontal region.	To duty; 6 days.	Passenger in car that collided with railroad underpass due to fog.
Pvt., 19	Laceration, 1 inch, palm of right hand; contusion, right elbow.	To duty; 18 days.	Pedestrian—was hit by oncoming car while standing on side of highway.
Pvt., 21	Dislocation right femur at hip; laceration, ½ inch cheek; D. U. fracture right ulna.	To duty; 12 days.	Pedestrian—was crossing highway and staggered backward into car.
Pvt., 18	Injury, right shoulder	To duty; 23 days.	Pedestrian—crossing street in D. C., stepped back from oncoming taxicab into path of another car which struck him.
Pfc., 23	Laceration, forehead, right cheek, right hand; abrasion, right knee.	To duty; 48 days.	Pedestrian—while walking was hit by car from rear.
Cpl., 27	Punctured wound, right cheek, ½ inch.	To duty; 5 days.	Passenger—while jumping off running car patient fell on pavement, causing the injury.
Pvt., 22	Fracture, simple proximal, phalanx right thumb.	To duty; 19 days.	Passenger—while cranking a liberty truck, it backfired and kicked.
Pvt., 22	Fracture, simple proximal, phalanx right thumb.	To duty; 23 days.	Driver of car—while cranking liberty truck the crank slipped and hand hit bumper.
Sgt., 26	Fracture, simple proximal, phalanx right thumb.	To duty; 23 days	While cranking truck it backfired.
Pvt., 20	Fracture, fifth metacarpal bone, right hand.	To duty; 22 days.	While cranking truck it backfired.
Pvt., 24	Laceration, lower lip	To duty; 10 days.	Passenger—head-on collision with another car.
Pvt., 23	Laceration, left eyelid, right forearm, and left forearm.	To duty; 16 days.	Passenger—head-on collision.
Pvt., 30	Laceration, left eyebrow and right knee.	To duty; 16 days.	Passenger—head-on collision with truck.
Ret. Sgt., 43	Laceration, left elbow; laceration right face.	To duty; 13 days.	Driver of car in head-on collision with another car.
HA 1 c, 21	Laceration, forehead	To duty; 52 days.	Passenger—driver lost control of car on curve and hit telephone pole.
Pvt., 22	Laceration, nose and left knee	To duty; 16 days.	Driver—rounding curve on left-hand side of road. Head-on collision with another car.
Pvt., 20	Laceration, scalp and right shoulder; contusion, back.	To duty; 2 days.	Passenger—driver hit a truck head-on. Patient was asleep in back seat.
Pvt., 19	Contusion, left foot	To duty; 13 days.	While pulling loaded trailer, foot slipped under front wheel.
Pvt., 21	Contusion, lumbar region	To duty; 3 days.	Passenger—driver collided with railroad underpass due to fog.
Pfc., 21	Laceration over right eye	To duty; 2 days.	Passenger—driver collided with railroad underpass due to fog.
Sgt., 32	Laceration, left elbow; contusion, left side of scalp.	To duty; 4 days.	Passenger—tire blew out and car overturned.
Cpl., 26	Compound fracture, left clavicle; laceration, left forehead and shoulder.	To duty; 90 days.	Driver of car which was forced off road into ditch.
Cpl., 23	Fracture, simple, first phalanx right fourth finger.	To duty; 15 days.	Driver—while cranking truck it kicked back.
Pvt., 22	Laceration, forehead, nose, and upper gums; fracture, simple, fourth cervical vert.	To duty; 19 days.	Passenger in tank which struck a tree.
Pfc., 26	Laceration, left elbow and scalp; fracture, ribs.	To duty; 15 days.	Driver of car in head-on collision with another car.
Pvt., 21	Lacerations, lower lip and right forehead.	To duty; 44 days.	Driver—fell asleep, hit post, and overturned.
Sgt., 32	Fracture, right patella; contusion, right hip and right arm.	To duty; 42 days.	Driver of car which collided with railroad underpass while rounding a curve in rain and fog.
Cpl., 25	Fracture, simple, second, fourth, and fifth right metacarpals.	To duty; 9 days.	Passenger—riding behind driver and could not see what occurred.
Sgt., 40	Laceration, right leg, lower lip; three teeth knocked out.	To duty; 37 days.	Driver of car on which tire blew out—car overturned.
Sgt., 30	Fracture, left clavicle	To duty; 52 days.	Driver—blinded by oncoming car and ran off road, overturning.
Asst. Ck., 38	Compound fracture, nose	To duty; 40 days.	Passenger of car which ran into back of parked truck.
Pvt., 29	Burns and injuries, multiple extreme. Dead upon arrival.	D. D.; 0 days.	Driver of car which collided head on with a truck.
Pvt., 21	Wounds, multiple extreme	D. D.; 0 days.	Driver of truck which was struck by a passenger train.
Pfc., 29	Injuries, multiple extreme	D. D.; 0 days.	Driver of tractor which ran over large stone and overturned.
Pvt., —	Contusion, occipital region; laceration, scalp.	D. D.; 1 day.	Driver of motorcycle which drove into car from rear.
Cpl., 41	Carbon-monoxide poisoning	D. D.; 0 days.	Driver of car—found dead.

The following tabulation (table 9) presents the injuries and disabilities among civilians treated by the Medical Department, Marine Barracks, Quantico, Va., during the calendar year 1937:

TABLE 9

Age, sex, and race	Extent of injury	Passenger or driver, cause, etc.	Retained in sick quarters—yes or no
55, male, white	Fracture, left femur; fracture, ribs with puncture left lung; contusion, forehead; laceration, right leg and elbow.	Driver of car in head-on collision	Yes.
30, female, white	Lacerations, extreme scalp; intracranial injuries; fracture ribs; lacerations, multiple, both legs.	Passenger in car involved in head-on collision.	Yes.
?, male, white	Wounds, multiple extreme (D. D.)	Passenger in truck hit by train	No.
43, male, white	Wound, 6 inches, forehead and scalp; laceration, 2 inches, occipital region.	Passenger in rear of car involved in head-on collision.	Yes.
68, male, white	Lacerations, forehead	Driver of car which skidded and overturned on wet pavement.	Yes.
31, male, white	Laceration, 6 inches, occiput; laceration, 2 inches, right forehead; laceration nose; contusion, left eye and left forehead.	Driver of car which skidded and overturned.	Yes.
18, male, white	Wounds, multiple extreme; fractured skull and mandible.	Passenger in car which ran into rear of truck.	Yes.
28, female, white	Sprain, left ankle and right elbow; large abrasion left hip.	Passenger in car, and while attempting to close door she accidentally fell out.	Yes.
40, male, white	Laceration, 3 inches, forehead; fracture, left upper rib.	Passenger in car involved in head-on collision.	Yes.
40, male, white	Burns, second degree, right leg; fracture, right patella; lacerations, both legs, face, and scalp.	Driver of car in head-on collision	Yes.
56, female, white	Laceration, 3 inches, forehead; laceration, 2 inches, left knee.	Passenger in car which sideswiped another and overturned.	No.
30, male, white	Laceration, 2½ inches, scalp	Driver of car which was sideswiped by another.	No.
20, female, colored	Contusion, left hip	Passenger in car which sideswiped another.	No.
27, female, white	1-inch laceration, right eyebrow	Pedestrian—hit by car while walking along the highway.	No.
7, male, white	Fracture, left clavicle	Fell off bicycle and struck sidewalk	No.
23, female, white	Fracture, right radius and ulna; lacerations, face, scalp, and both knees.	Passenger in car involved in head-on collision.	No.
25, male, Negro	Fracture, left patella; laceration, chin.	Driver of car which collided head-on with another car.	No.
25, male, Negro	Lacerations, upper lip and left leg; fracture, mandible.	Passenger in car involved in head-on collision.	No.
25, male, Negro	Pronounced dead upon arrival	Passenger in car involved in head-on collision.	No.
5½, male, Negro	Multiple lacerations, left scalp	Passenger in car which skidded, ran into bank, and overturned.	No.
22, female Negro	Sprain, right angle	Passenger in car which ran out of control while rounding a curve and ran into a bank.	No.
36, female, Negro	Fractured rib, right side; contusion, back.	Passenger in car which skidded on curve and overturned.	No.
50, male, white	Multiple lacerations, right leg, right ear, and contusion, neck.	Driver of car involved in head-on collision with car on wrong side of road.	No.
40, female, white	Multiple lacerations, right elbow	Passenger in car which collided head-on with another.	No.
52, male, Negro	Contusions, left hip; abrasions, right occiput and left shin.	Driver of car—lost control on curve and hit bank.	No.
27, male, Negro	Lacerations and contusions, scalp, face, and left shoulder.	Passenger in car which went out of control on curve and hit a bank.	No.
40, female, Negro	Lacerations, scalp and face	Passenger in car which went out of control on curve and hit a bank.	No.
18, male, white	Contusion, left eye with ecchymosis	Driver of car which hit an unknown object head-on.	No.
—, male, white	Contusions, left shoulder and face	Driver of car which caught afire—jumped out while car was in motion.	No.
20, female, white	Contusion, head	Passenger in car which drove off left-hand side of road.	No.

TABLE 9—Continued

Age, sex, and race	Extent of injury	Passenger or driver, cause, etc.	Retained in sick quarters—yes or no
31, male, white	Laceration, ½ inch, right middle finger.	Caught finger in car door while closing it.	No.
32, male, white	Incised wound, ½ inch, left buttock.	Driver of truck which skidded on wet pavement and overturned.	No.
27, male, white	Contusion, left chest	Driver of truck—lost control and ran off road.	No.
65, female, white	Contusion, chest	Passenger in car which swerved to to avoid another, and in so doing, overturned.	No.
14, male, white	Abrasion, left forearm	Bicycle slipped and patient was thrown off onto pavement.	No.
44, male, Negro	Contusion, right temple; sprain, back.	Passenger in car which ran off road, overturned, and struck telephone pole.	No.
24, male, Negro	No evidence of injury (intoxicated).	Passenger in car which ran off road, overturned, and struck telephone pole.	No.
36, female, Negro	Wound lacerated, forehead, scalp, face, and right hand.	Passenger in car which ran off road, overturned, and struck telephone pole.	No.
23, male white	Multiple lacerations, scalp and face; contusion chest.	Driver of car which ran into rear of truck.	No.
35, male, white	Fracture, left thigh; laceration, scalp.	Passenger in car which ran into rear of truck.	No.
24, female, white	Abrasions, left buttock, left shoulder, right forearm, chin, and right cheek; laceration, 1 inch, left eyebrow.	Passenger on motorcycle which hit gravel on a curve and overturned.	No.
26, male, white	Laceration, left knee, left wrist, and right elbow.	Driving motorcycle which hit gravel on a curve and overturned.	No.
24, female, Negro	Lacerations, face and forehead	Passenger in car which struck another head-on on a curve.	No.
24, female, Negro	Lacerations, face	Passenger in car which struck another head-on on a curve.	No.
22, male, Negro	Incised wound, dorsum of right hand	Driver of car which collided with another head-on.	No.
27, male, white	Shock	Passenger in car involved in head-on collision.	No.
58, male, white	Contusion, left knee	Passenger in car which skidded and ran into a bank.	No.
72, female, white	Compound fracture, left tibia	Passenger in car which skidded, left highway, and overturned.	No.
28, male, white	Contusions, right chest and knee	Passenger in car which skidded, left highway, and overturned.	No.
24, female, Negro	Contusion, back	Passenger in car which slid on curve and overturned.	No.
18, female, white	Lacerations, scalp; contusion, right foot.	Passenger in car involved in head-on collision.	No.
20, male, white	Abrasion, right wrist and elbow; contusion, right leg.	Driver of car involved in head-on collision.	No.
22, male, white	Fracture, left femur; laceration, scalp, 4 inches.	Passenger in car involved in head-on collision.	No.
60, male, white	Fracture, mandible and left innominate; laceration, left forehead.	Driver of car which collided head-on with another.	No.
21, male, Negro	Abrasion of hands	Passenger in car involved in head-on collision.	No.
25, male, Negro	Lacerations, occipital region; 2½ inches, right ear.	Passenger in car involved in head-on collision.	No.
25, male, Negro	Lacerations, forehead, face, elbow, and scalp.	Passenger in car involved in head-on collision.	No.
19, male, Negro	Lacerations, 1 inch, right arm; contusion, pelvis.	Driver of car which collided head-on with another in middle lane.	No.
—, female, Negro	Lacerations, eyebrow, right shoulder, right arm and forearm, and left elbow.	Passenger ? (intoxicated)	No.
22, female, white	Probable internal injuries	Passenger in car forced off road by another car.	No.
42, male, white	Dislocation left shoulder	Driver of car which skidded on road and overturned.	No.
21, female, white	Compound fracture right femur; fracture left tibia; fracture left fibula.	Passenger. Circumstances not known.	No.
35, female, white	Facture left humerus; wound, lacerated (2 inches) forehead.	Driver of car on wet pavement; skidded and sideswiped a tree.	No.
22, male, white	Contusion left chest and lacerated left forehead.	Passenger in car which skidded on road and hit tree.	No.
24, female, white	Lacerations, severe, nose and upper lip; contusion, left chest.	Passenger in car involved in head-on collision.	No.
21, female, white	Lacerations, face and neck	Passenger in car which collided with truck.	No.

TABLE 9—Continued

Age, sex, and race	Extent of injury	Passenger or driver, cause, etc.	Retained in sick quarters—yes or no
32, male, white	Contusion, right shoulder and hip; fracture of ribs, right upper chest.	Passenger—thrown from car after catching a ride.	No.
21 months, female, white.	Contusion, nose	Passenger in car which stopped suddenly, throwing child against framework of car.	No.
18, male, white	Contusion, left knee, thigh, arm, and parietal region.	Pedestrian—while placing tools in telephone truck, truck was struck in rear.	No.
45, male, white	Contusion, left thigh and elbow; abrasions, left thigh and elbow.	Pedestrian—while placing tools in telephone truck, truck was struck in rear.	No.
2, female, white	Abrasion, lumbar region	Pedestrian—was struck by car backing out of garage.	No.
18, male, white	Severe contusions, both legs	Pedestrian—struck from behind by auto while walking down street.	No.
7½, male, white	Abrasions, right side and both great toes.	Pedestrian—walked in front of truck from sidewalk.	No.
19, female, white	Contusion, chest	Passenger in car of which driver lost control, running into ditch.	No.
67, male, white	Wound, lacerated (¼ inch) right cornea; abrasions, face and hands.	Driver of car which sideswiped another.	No.

FOOD POISONING

IN THE FIRST MARINE BRIGADE, FLEET MARINE FORCE, CULEBRA, P. R.

By Lieutenant Commander J. B. O'NEILL, Medical Corps, United States Navy

At noon on February 6, 1938, 20 persons at the brigade staff officers' mess ate cooked fish, and from 1:15 p. m. to 7 p. m., all but 1 of the persons who had eaten of the fish became acutely ill.

The responsible fish, a female roe amberjack (*Seriola fasciata*), was caught between 2 and 3:30 p. m. February 5, about one-half mile south of Cayo Agua, a small cay about 2 miles west of Culebra. It was pronounced by a native fisherman to be an edible fish and was placed in a live well of the boat. It remained there until about 4:30 p. m., when it was transported to the camp ashore and placed on ice, less than an hour after the fish died. The fish was ordered cleaned before being placed on ice but this was not done. On the morning of February 6 the fish was cleaned and filleted. The fillets were broiled for 20 minutes, baked in an oven for 2½ hours, and served at the noon meal. Most of the mess ate heartily, several commenting on the unusually fine flavor of the fish. Some ate of the roe, cooked with the fish, but most did not.

The symptoms were predominantly gastrointestinal, genito-urinary, and nervous. The symptoms and signs during the first 12 hours were:

Metallic taste in mouth.
Burning sensation in epigastrium, spreading later over the entire abdomen.
Nausea and vomiting.
Profuse watery diarrhea with colic.
Frequent scalding urination.
Weakness and aching of arms and legs.
Dizziness.
Flushing of face.

On the following morning (February 7), most of the gastrointestinal symptoms had ameliorated and many of the patients ate breakfast without distress. All complained of most the following symptoms:

Frontal headache.

Weakness and aching of arms and legs.

Hyperesthesia of extremities. There was numbness, tingling, and itching, which was accentuated by washing in cold water or touching a cool surface.

Hyperesthesia of mouth and tongue without disturbance of taste. Drinking of cold water caused severe burning of the mouth and tongue and, in three cases, of the teeth also.

Frequent scalding urination.

Sleeplessness and nervousness.

Diminished patellar and Achilles reflexes in most cases.

Petechiae of upper arm and lower legs in several cases.

Urine showed albumin, granular casts, and mucus in most cases. Some urine specimens were tested for copper and found negative.

On February 8, the following symptoms and signs were present in most of the cases:

Hyperesthesia of extremities, mouth, and tongue.

Nervousness and sleeplessness.

Diminished or absent patellar and Achilles reflexes, with negative Rhomberg.

On February 16, 10 days after the onset of symptoms, no one case had made a complete recovery though none are incapacitated for duty. The residual symptoms consist principally of burning of the mouth and tongue on drinking cold liquids, itching of the hands and feet, weakness of legs, and diminished reflexes.

The following treatment was given: Early elimination by the use of purgatives; salt in cases showing dehydration; stimulation with hot black coffee; relief of pain by hot-water bottles; morphine, when required; and for several days after the attack, sedatives and hypnotics as required.

Amberjack and barracuda from the same locality as the fish responsible for these cases of poisoning have been eaten a number of times without causing symptoms of toxicity. One amberjack, caught at the same time as the toxic fish, was cleaned, salted, placed on ice on February 5, and eaten without ill effects on the following day.

Upon inquiry three fishermen made statements essentially as follows:

(1) Until 10 years ago we never had this trouble here and we could eat any fish we caught here. We have always known that fish caught around St. Thomas, near Sail Rock, near Culebrita, and on the north coast of Vieques sometimes made people sick. They all get over it, but it leaves them with bad legs for some time. I never heard of anyone dying of it. Most fish here never make people sick. It is only some kinds. The fish most apt to be poison are the *picuda* (*barracuda*), the *jurel* (*skipjack*), the *medregal* (*amberjack*), and the *cojinua*. Three years ago I caught a barracuda on the north coast of Vieques and before I returned to Culebra in about 3 hours the fish died. A man begged me to sell him some. I did not want to do it but he begged me so hard I did. I cleaned the fish

and while I was doing it my cat licked up some of the blood but did not eat any of the fish. The next day the cat's legs were all limber and it could not walk straight. The man that ate the fish was sick too and had much trouble with his legs. It took the man a month to get well and the cat died. The lobsters never give this sickness and most of the other fish do not. It is only the big fish, the old ones, that do.

(2) We only have this trouble in 3 months—November, December, and January. During these months the wind blows strong from the east (the northeast trade winds). We know that fish to the east of Culebra eat something that makes them poison, and when the water gets rough over there those fish come around to the west side of this island. When you catch one of those fish that has come here and eat it, you get sick. Many of these people get sick that way.

(3) Most of the older people have had this trouble and we do not think much about it. You cannot tell by the taste of the fish whether it is poisonous or not. Generally, people put a silver spoon with the fish while it is cooking. If the spoon turns black the fish is bad and they throw it away; if it does not turn black the fish is good. When they get sick the people here take the young leaves of the *mangre* and make a strong tea of it and put in some sugar. They drink a little of the tea every little while, and the trouble with the legs is gone in 7 or 8 days. Without this tea most people are all right in 3 weeks, but some have trouble for 3 months. The *mangre*, also called *botoncillo*, is a kind of a mangrove, but does not grow in the water, but in the sandy soil close to it. I have seen many cases of this sickness. I have two pigs that ate *jurel*. They had trouble with their legs for weeks but are all right now only they eat too much. The pigs are not as big as the other ones of the same litter. The *jurel* is nearly always bad and so is the *cojinua*. Young *picudas* are all right and so are the *medregals*, it is only the old ones that are bad. Even the kingfish when it is big is sometimes bad.

Dr. Laujier, public health officer of Vieques, stated "We never have any fish poisoning in Vieques. I never heard of a case here."

Certain data regarding the toxic substance may be considered definitely assured:

(*a*) It is not universally present in the fish of a species in these waters.

(*b*) It is thermostable, having resisted 20 minutes broiling and 2½ hours of baking.

(*c*) It is a gastrointestinal irritant, a genito-urinary irritant, and it is toxic to the nervous system, apparently affecting chiefly the peripheral nerves.

FISH POISONING IN CULEBRA-VIRGIN ISLANDS AREA

By Captain W. L. MANN, Medical Corps, United States Navy

The outbreaks of fish poisoning in February 1938 during fleet exercise No. 4 were similar in many respects to one observed in wardroom mess of the cruiser *Tennessee* in 1909 at Honolulu, T. H., caused by toxic species of fish.

Historical.—*Ciguatera* is the Spanish term for fish poisoning in the West Indies. The word, originally written *Siguatera* in 1787, is derived from *Cigua*, a poisonous marine snail, present in Cuban waters.

Peter Mayer, the first historian of the West Indies, wrote in 1530 of a tree whose fruits were sure poison. "When fruits fall into the water and are eaten by the fish, people who afterwards eat these fish are attacked by divers strange maladies."

Gudger believes this tree to be the manchineel (*Hippomane mancinella*).

One observer, in 1675, reports "Many of the fishes are poysonous, bringing great pain, with several days of itching."

This affection was described several times in the 1700's, and numerous articles appeared in the 1800's (Cudger).

Naval medical officers, particularly Walker, have made detailed description of the clinical syndrome caused by ingestion of fish caught in waters off St. Thomas, Virgin Islands.

Icthyotoxismus has been reported for the West Indies by modern authors—Rosenau, Gudger, and others.

The following toxic fish are found in Culebra, Virgin Islands area:

Family *Carangidae*—Pompano. (a) Amberjack—*Seriola fasciata*. Generally called *medregal*. It closely resembles the California *yellowtail*. (b) Skipjack—*Caranx latus*. Generally called *jurel* or *cavalla*. Other names are *horse-eyed mackerel*, *horse-eyed jack*, *yellow jack*. (c) Yellow-tail—*Elongatus bipinnulatus*. Generally called *cojinua*.

2. Family *Scombridae*. (a) Kingfish—*Scomberomorus cavalla, regalis, pintado*, or *sierra*. Generally called *cera*, or *sierra*. The *giant kingfish* or *spotted mackerel*.

3. Family *Sphyraenidae*. Barracuda—*Sphyraena barracuda*. Generally called *picuda* or *becune*.

The fishermen in the Virgin Islands include the *red snapper* among the list of toxic species.

Impression of nature of toxin:

1. An alkaloid.
2. Thermostable and resistant to drying.
3. A physiological toxin.
4. No connection with *Salmonella enteritidis*, or others of Gartner group.
5. It is not a food toxemia due to botulism, as cooking does not affect the toxin.
6. An unknown local factor causes certain species to be poisonous.
7. The unknown factor is definitely restricted in location and is sometimes limited to a water area of a few square miles.

The localized distribution of toxic fish has been attributed to feeding of fish on poisonous food in certain fishing grounds. For example:

1. Algae plants in proximity to old copper mine.
2. Berries from manchineel tree.
3. Poisonous moss or mollusks.
4. Species of marine plant called *cobriza*.

Symptoms:

General.—Symptoms appear suddenly, from 1 to 6 hours after ingesting the fish. The clinical symptoms are severe, and the patient's general condition is more critical than those observed in outbreaks of food poisoning in our naval service.

Gastrointestinal.—Nausea, vomiting, diarrhea, metallic taste in mouth.

Cutaneous.—Flushing of skin, tingling sensation, and itching, often severe and lasting for several days. A British naval surgeon in Barbadoes reports a case of skin eruption like leprosy, persisting for years, with nails of hands and feet falling out.

Motor system.—Weakness in legs. In the case of a civilian woman, paralysis of lower extremities existed for several months. Diminished or absent patellar reflex. In acute attacks there are cramps of muscles of arms and legs.

Nervous system.—Hyperesthesia and paresthesia of extremities, mouth, and tongue. Cold food and drinks give a burning sensation to mouth and tongue. A cold metal railing feels warm to the grasping hand—this symptom is almost diagnostic and persists for weeks. Nervousness, restlessness, and insomnia are present.

Urinary system.—Albumin and casts in urine. Frequent micturition.

Diagnosis:

The clinical syndrome caused by ingestion of the toxic fish caught in Culebra-St. Thomas waters may be differentiated from the disorder caused by *Clostridium botulinum* by the following:

1. Elevated temperature.
2. Early onset of symptoms.
3. No detoxication of food by cooking.
4. Lower case fatality rate.
5. Presence of sensory disturbances.

It may be differentiated from "food infection" by the Gartner group bacillus by:

1. Clinical symptoms are apt to be more severe.
2. Prolonged convalescence.
3. Paresthesia of hands, mouth, and tongue.
4. Cutaneous itching.
5. Causative factor not destroyed by cooking.

The diagnosis of fish poisoning may be made on:

1. History of eating fish within 1 to 10 hours.
2. Metallic taste.
3. Paresthesia—contact with cold objects giving a warm sensation.
4. Prolonged convalescence.

One officer who had eaten of an amberjack 4 weeks previously noticed that when eating ice cream it felt so hot to his mouth that he subconsciously blew his breath on the ice cream in order to cool it.

The burning sensation caused by cold objects is regarded as pathognomonic of this type of fish poisoning.

SUMMARY

The tentative conclusions seem to be warranted that:

1. Toxic fish are present in certain well-defined areas.
2. The same species may be nontoxic in other areas.

3. There is a seasonal influence on the toxicity.
4. Individual fish of the same species caught in the same area on the same day vary in their toxicity.
5. The symptoms are caused by a specific toxin, the nature of which is undetermined.
6. The symptoms are so severe that all visitors should avoid eating any fish caught in Culebra-Virgin Island area.

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FOOD POISONING

ON BOARD THE U. S. S. "PHILADELPHIA"

By Commander Oscar Davis, Medical Corps, United States Navy

At about 1 p. m. on January 19, 1938, the day of sailing from San Juan, P. R., men began to complain of colicky pains in the upper abdomen, weakness, and frequent loose, watery stools. Most of the 24 men admitted to the sick list had nausea, and vomited, and 8 complained of pain in the legs.

The symptoms presented on the first day were quite severe, all of the patients appearing quite toxic and weak, with temperatures ranging from 102° F. to 105° F. The temperatures of those admitted on the second day were not as high, to 102° F., and for those admitted on the third day the temperature did not go above 101° F.

Investigation revealed that each man had been ashore and that 8 of them drank water, 23 drank iced drinks at the ship's service store aboard ship, and those men not drinking iced drinks at the ship's service store drank iced tea at meals aboard ship. Ice obtained from ashore in San Juan was used in iced drinks served at the ship's service store and in iced tea served to the general mess at meals. The medical officer was informed that the ice was certified as to quality. This statement was accepted as a reasonable guarantee that the ice was fit for human consumption.

The above information covered the period of time the ship was in San Juan, P. R., from January 15 to 18, inclusive, which would give an incubation period of from 3 to 5 days. The ice was used in

iced tea first on January 15 and the first symptoms were noted by the men on January 18 though not reported until they became quite ill on January 19. The onset was sudden, with sharp pains in the upper abdomen. The symptoms in most instances subsided in 4 days and convalescence was relatively slow Intestinal colic and frontal headache were present as was also a loose, watery diarrhea with frequent stools. There was moderate prostration. The pulse rate was in normal relation to the temperature, regular, and of good quality. Blood pressures were within normal limits. Respiration was not markedly increased and blood counts showed about 15,850 WBC with differential of 18 bands, 66 segments, 15 lymphs, and 1 monocyte.

On the outbreak of symptoms the question of food as a possible source was investigated and could not be connected with the outbreak. The ice aboard was cultured, found contaminated and was thrown overboard. Ice was then furnished the ship's service store from the ice made aboard ship from ship's water. The men affected were in various messes and no one mess showed a majority of cases. Some few men in the crew did not take iced tea but it is believed the majority did. No cases appeared from the captain's, wardroom, or warrant officer's messes, all of which used ice made aboard ship.

The bacteriological findings were as follows:

January 15, 1938.—Harbor water at San Juan, before and after passing through the ship's evaporators, cultured by Dominick and Lauter method and found to be contaminated by organisms of the *Coli-aerogenes* group. This was a test on the ability of the evaporators to clear the water if contaminated.

January 16, 1938.—Water from city lines showed slight contamination by organisms of the *Coli-aerogenes* group, by Dominick and Lauter method of culture. After the addition of iodine the water was again cultured and showed no reaction—negative.

January 17, 1938.—City water was conveyed to the ship's evaporators and distilled there. Tests from ship's tanks by Dominick and Lauter method showed no contamination.

January 19, 1938.—Ice taken aboard at San Juan showed contamination by organisms of the *Coli-aerogenes* group, by the Dominick and Lauter method, with 50 percent of gas after 26 hours of incubation. Broth culture made from ice, and after incubation gram stain was made, which showed numerous gram negative bacilli, some with a tendency to bipolar staining.

January 20, 1938.—Recheck on ice showed fecal contamination with 50 percent production of gas after 26 hours of incubation. Culture from broth made on Endo's media for colony formation. Growth of small grayish colonies.

January 20, 1938.—Feces cultured from patient in sick bay shows some small grayish colonies on Endo's media. Gram stain shows gram negative bacilli with a tendency to bipolar staining. Organism was similar in all respects to that isolated from the ice.

January 25, 1938.—Agglutination test made, using serum from patient and antigen prepared from organisms isolated from ice. Agglutination positive in dilution of 1 to 640.

STATISTICS

HEALTH OF THE NAVY

The regular coding work of the statistical section of the Division of Preventive Medicine has been delayed by the installation of new statistical machinery. For this reason it has not been possible to prepare for publication in this issue the usual summary of the Health of the Navy.

Monthly reports of communicable diseases received in the Bureau recorded the following incidence of disease:

Common infectious diseases of the respiratory type.—During the first quarter of 1938 a total of 4,354 cases of the common infections of the respiratory type were recorded for the entire Navy, as compared with 3,152 admissions for the preceding quarter and 8,068 admissions for the first quarter of 1937.

There were 2,124 admissions for these diseases reported by shore stations in the United States, 286 from outlying naval stations and activities, and 1,944 from the forces afloat. The largest numbers of cases were reported from the following ships and stations:

Ship or station	January	February	March	Total
U. S. S. *Lexington*	12	13	545	[1] 570
Naval training station, Norfolk, Va.	168	171	131	470
Naval training station, Newport, R. I.	150	129	188	467
Regimental hospital, Fourth Marines, Shanghai, China	87	87	35	209
Naval training station, Great Lakes, Ill.	68	46	64	178
Naval training station, San Diego, Calif.	55	38	72	165
U. S. Naval Academy (midshipmen)	42	44	46	132
Naval air station, Pensacola, Fla.	33	19	25	77
Naval air station, Norfolk, Va.	16	25	24	65
Marine barracks, Quantico, Va.	14	23	19	56
Navy Yard, Portsmouth, N. H.	17	11	26	54
Marine detachment, American Embassy, Peiping, China	24	17	7	48
Submarine base, New London, Conn.	11	23	12	46
U. S. S. *Raleigh*	10	20	15	45

[1] Form F cards received in the Bureau indicate a total of 595 cases of upper respiratory infections admitted to the sick list on the U. S. S. *Lexington* during the epidemic from Mar. 10 to Mar. 31, 1938. A check on incidence according to rate reveals no cases admitted from the junior officers' mess, the warrant officers' mess, or the chief petty officers' mess, and only 1 case, a supply officer, from the wardroom mess.

Scarlet fever.—Five cases of scarlet fever were reported for the quarter—One in January and one in March from the naval training station, Newport, R. I.; one in January from the U. S. S. *Saratoga;* and in February one each from the Navy Yard, Boston, Mass., and the U. S. S. *Saratoga*, fleet air detachment, United States Naval Air Station, San Diego, Calif.

Chickenpox.—There were 16 cases of chickenpox reported during the first quarter of 1938, as follows:

Ship or station	January	February	March
U. S. S. *Raleigh*	1	2	1
Marine barracks, Quantico, Va.	0	0	2
U. S. S. *Preston*	0	0	2
U. S. S. *Argonne*	0	0	1
U. S. S. *Detroit*	0	0	1
U. S. S. *Lexington*	1	0	0
U. S. S. *Mississippi*	1	0	0
Submarine base, New London, Conn.	0	1	0
U. S. S. *Philadelphia*	0	0	1
Marine Corps base, San Diego, Calif.	1	0	0
U. S. S. *Teal*	0	0	1

One case of diphtheria was admitted to the sick list on board the U. S. S. *Langley* in March.

In reporting the occurrence of malaria among personnel attached to stations in the vicinity of Balboa, medical officers reported as follows:

DISTRICT MEDICAL OFFICER, FIFTEENTH NAVAL DISTRICT, BALBOA, CANAL ZONE

Sanitary report for January 1938.—Health conditions within the fifteenth naval district have been good with the exception of increased malaria admissions. The incidence of malaria shows the usual increase to be expected at the end of the rainy season. Eight cases developed during the month among personnel attached to stations in the vicinity of Balboa. Among the personnel of the radio station at Summit, Canal Zone, three cases were admitted. Five cases developed at the naval ammunition depot, Balboa—one malignant tertian, three benign tertian, and one recurrent benign tertian.

U. S. S. "NITRO"

Special report dated January 27, 1938.—The dock at the new naval ammunition depot is located in line of flight of the Anopheline which are prevalent in this locality. In anticipation of this condition the *Nitro*, prior to docking at this station on January 10, 1938, provided individual nets, and attempts at screening were instituted. Ship's personnel in going to and from the station about 2 miles distant and while attending movies on deck during the evening hours were exposed. Two admissions for estivo-autumnal malaria were recorded on January 24 and one on January 25.

THE SANITARY REPORT FROM THE NAVAL STATION, GUAM MIDWAY ISLAND

The January 1938 sanitary report contained the following data regarding whooping cough: This disease continues in epidemic form throughout the towns and villages of Guam—55 deaths during the month of January 1938. A total of 109 deaths have been recorded since the beginning of the present epidemic. The age group most seriously affected is from 6 months to 3 years, mostly those about 1 year old. During the past month the disease has spread to Merizo, Umatac, and Inarajan in increased proportions, due to the fact that the epidemic's momentum has increased there, whereas it is abating somewhat in Agana and Anigua. Respiratory infections like pertussis are almost impossible to control after once introduced into the island.

The sanitary report for the month of February reported 27 deaths and the report for the month of March reported 4 deaths from whooping cough making a total of 145 deaths from this disease since the inception of the epidemic in 1937.

DEATHS

During the first quarter ending Mar. 31, 1938

Cause		Navy			Marine Corps		Nurse Corps	Total
Principal	Contributory	Officers	Midshipmen	Men	Officers	Men		
Average strength		9,818	2,150	103,555	1,326	17,172	411	134,432
DISEASE								
Abscess, axilla	Septicemia	1						1
Abscess, liver	None			1				1
Anomaly of form, coronary artery.	do			1				1
Carbuncle, face	Septicemia			1				1
Carbuncle, neck	do			1				1
Carcinoma, lung	Carcinoma, general and abscess mediastinal.			1				1
Carcinoma, pancreas	None	1						1
Carcinoma, prostate	do	1						1
Do	Myocarditis, chronic			1				1
Cellulitis, neck	Agranulocytosis			1				1
Cerebrospinal fever	Abscess, multiple, brain			1				1
Diabetes mellitus	Myocarditis, chronic and enlargement, prostate.	1						1
Gastroduodenitis, acute	None			1				1
Gonococcus infection, meninges.	Pneumonia, broncho			1				1
Leukemia	None			1				1
Meningitis, cerebrospinal, acute.	do			2				2
Obstruction, intestinal, from external causes.	do			1				1
Pericarditis	do			1				1
Pneumonia, broncho	Dilatation, cardiac, acute					1		1
Pneumonia, lobar	None	1		8				9
Poliomyelitis, anterior, acute.	do			1				1
Purpura hemorrhagica	do			1				1
Sarcoma, lympho, stomach	Peritonitis, general, acute			1				1
Septicemia	None		1					1
Syphilis	Poisoning, neoarsphenamine and pneumonia, broncho.			1				1
Thrombosis, cerebral	None			1				1
Thrombosis, coronary	do	1		2				3
Tuberculosis, pulmonary, chronic, active.	do			1				1
Ulcer, stomach	Peritonitis, general, acute	1						1
Total for disease		7	1	31		1		40
INJURIES AND POISONINGS								
Asphyxiation, illuminating gas.	None			1				1
Asphyxiation, kerosene oil smoke.	Alcoholism, acute					1		1
Asphyxiation, vomitus in trachea.	None					1		1
Burn, multiple	do	1						1
Drowning	do	3		9				12
Electric shock, injury from	do			1				1
Fracture, compound, skull	do	1		1				2
Fracture, simple, skull	do			1		1		2
Do	Hemorrhage, subdural			1		1		2
Do	Meningitis, cerebrospinal, acute.			2				2
Intracranial injury	None			1				1
Do	Meningitis, cerebrospinal, acute.			1				1

DEATHS—Continued

During the first quarter ending Mar. 31, 1938—Continued

Cause		Navy			Marine Corps		Nurse Corps	Total
Principal	Contributory	Officers	Midshipmen	Men	Officers	Men		
INJURIES AND POISONINGS—continued								
Injuries, multiple, extreme	None	4		14				18
Wound, gunshot, abdomen	Pneumonia, lobar			1				1
Wound, gunshot, chest	None					1		1
Wound, gunshot, head	do	1		2		2		5
Wound, infected, thigh	do			1				1
Wound, incised, wrist	Poisoning, carbon monoxide.			1				1
Total for injuries and poisonings.		10		37		7		54
Grand total		17	1	68		8		94
Annual death rate per 1,000:								
All causes		6.93	1.86	2.63		1.86		2.80
Disease only		2.85	1.86	1.20		.23		1.19
Drowning		1.22		.35				.36
Poisonings								
Other injuries		2.85		1.08		1.63		1.25

MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

Statistics for first quarter ending March 31, 1938

The following statistics were taken from sanitary reports submitted by naval training stations:

January, February, and March 1938	U. S. naval training station			
	Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	1,144	845	866	1,340
Recruits appearing before board of medical survey	8	0	2	0
Recruits recommended for discharge from the service	8	0	2	0
Recruits discharged by reason of medical survey	8	0	(1)	0
Recruits held over pending further observation	0	0	(1)	(1)
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	0	22	113	39

[1] Not reported.

The following table was prepared from reports of medical surveys in which disabilities or diseases causing the surveys were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Absence acquired, teeth	1	Hammer-toe	2
Acne vulgaris	2	Hemorrhage, subarachnoid	1
Adhesions, abdominal	1	Hernia, inguinal	1
Amblyopia	1	Hernia, recurrent after operation	1
Aneurysmal varix, superficial vein, forehead	1	Metatarsalgia, left	1
Arterial hypertension	2	Myopia	2
Arthritis, chronic	3	Myositis, chronic	1
Asthma	2	Narcolepsy	1
Caries, teeth	2	Nephritis, chronic	3
Cataract	1	Otitis media, chronic	5
Cicatrix, skin	1	Paralysis, ocular muscle	1
Constipation	1	Pes cavus	1
Constitutional psychopathic inferiority, without psychosis	9	Psoriasis	1
Constitutional psychopathic state, emotional instability	7	Psychoneurosis, hysteria	3
Constitutional psychopathic state, inadequate personality	1	Psychoneurosis, unclassified	1
Deafness, bilateral	3	Retinitis	1
Defective physical development	3	Rhinitis, atrophic	1
Deformity acquired	3	Somnambulism	3
Dementia praecox	2	Stammering	1
Dislocation, cartilage, left knee	1	Strabismus	1
Dislocation, chronic, shoulder	1	Syphilis	2
Dyspituitarism	1	Tic	1
Eczema	2	Trachoma	2
Effort syndrome	2	Tuberculosis, pulmonary, chronic, active (moderately advanced)	1
Enterocolitis, chronic	1	Tuberculosis, pulmonary, chronic, arrested (moderately advanced)	1
Enuresis	10	Ulcer, duodenum	1
Epilepsy	4	Union of fracture, faulty	2
Flat foot	14	Valvular heart disease, combined lesions, aortic and mitral	1
Gastroptosis	1	Valvular heart disease, mitral stenosis	1

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